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Macroeconomic Factors and Housing Prices in the Helsinki Metropolitan Area

ABSTRACT:
The housing price fluctuations are closely linked to the development of the whole national economy. Macroeconomic changes, which can, to some extent, be impacted by the political decision-making, reflect widely to the functioning of the whole economy as well as to the housing markets. Because the changes in housing prices also affect the development of the macroeconomic factors, the relationship is interrelated. Thus, it is important to understand the drivers that influence housing price formation. Moreover, housing price fluctuations also affect households' wealth distribution and, hence, their consumption. The phenomenon is also known as the wealth effect.

The purpose of this study is to examine the movements between the key macroeconomic variables, i.e., the building cost index, the GDP, interest rate, the CPI, household debt, OMX Helsinki, and unemployment rate, and the housing price development in the Helsinki Metropolitan area, also referred as the HMA. The selected region is of particular interest as it is the capital region of Finland that comprises the majority of the economic activity of the country. Also, according to the previous studies, the housing prices in the HMA anticipate the housing price development elsewhere in Finland. The data for the housing price development in the HMA region is described by the price index of old dwellings. The empirical research part of the study is based on the OLS time series regression analysis, and the examined time period is from Q1 1990 to Q4 2019.

According to the results, the GDP, the building cost index, and OMX Helsinki variables exhibit statistically significant and positive co-movements with the housing price development of the HMA, as expected based on the previous literature. Moreover, the results show that the interest rate exhibits a statistically significant and negative movement with housing price development of the HMA. Yet, it can be argued whether the result is in fact as significant as the results show since the interest rate decreases throughout the observed time period. Household debt variable exhibit positive, yet, insignificant movement in regard to the housing price development of the HMA. The finding is in accordance with the previous studies, as the housing prices rise, the housing loans tend to increase. The movements of the unemployment rate and the CPI, on the other hand, are statistically insignificant, yet, negative. The negative sign of the coefficient of the unemployment rate is per the findings of the previous studies, yet, the result of the CPI is unexpected as the housing price fluctuations are typically included in the inflation measuring indices.

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Abbreviations

ADF = augmented Dickey-Fuller test

CPI = consumer price index

DF = Dickey-Fuller test

ECB = European Central Bank

GDP = gross domestic product

HMA = Helsinki Metropolitan area

OLS = ordinary least squares method

VAR = value at risk

VAT = value-added tax

1   Introduction

The development of housing prices is closely linked to the development of the whole national economy. Macroeconomic changes affect widely on the economy and, hence, also on housing markets. Studying the formation of housing prices is necessary as the price fluctuations have a significant impact on households' wealth distribution as well as on the global economy. A dramatic example of the latter is the subprime crisis that started in the United States in 2007, first causing a financial crisis that eventually led to a global recession. The subprime crisis originated from excessive mortgage granting to high-risk customers in hopes of high returns. As the housing prices plummeted, banks suffered major credit losses and, ultimately, caused difficulties in the global economy. As noted, housing price fluctuations have a major impact on the performance of the financial sector (see e.g. Goodhart & Hofmann, 2007). In addition, housing price fluctuations have a significant impact on households' wealth and, therefore, households' consumption as the majority of the wealth typically consists of homeownership (see e.g. Benjamin, Chinloy & Jud, 2004; Campbell & Cocco, 2007). This phenomenon is better known as the wealth effect and will be discussed further in the study.

The built environment accounts for more than 70% of Finland's national wealth, and construction investments account for 66% of the country's national fixed investments per year (Rakli, 2014, p. 2). Hence, the housing stock is a significant part of the total wealth of the economy, and, interestingly, the majority of the building stock consists of residential buildings (Oikarinen, 2011, p. 128). Jin and Zeng (2004) argue that residential investments are significantly more volatile in comparison with non-residential investments. In fact, Davis and Heathcote (2005) find that the standard deviation of residential investment in the United States is over twice compared to its non-residential counterpart. Yet, because of the increased risk of individual income and lower down payment requirements, the housing investment has become less volatile in recent years (Iacoviello & Pavan, 2013). Additionally, several studies (Jin & Zeung, 2004; Davis & Heathcote, 2005) provide evidence that residential investment leads the business cycle,

whereas the non-residential counterpart lags the cycle. Also, Davis and Heathcote (2005) find that both investment types, gross domestic product (GDP) and consumption exhibit positive co-movements.

Iacoviello and Pavan (2013) find that when the leverage is high, housing is less responsive to positive shocks, whereas the negative shocks have an even greater impact on housing, worsening the economic downturn. Oikarinen (2009b) detects a significant two-way relationship in the Finnish housing market between loan stock and dwelling prices since the financial deregulation in the late 1980s. According to the author, this interaction strengthens economic cycles as it boosts the upturns and, on the other hand, aggravates downturns. Thus, the linkage should be taken into account in the policy debate as its macroeconomic implications are significant. Also, the earlier study of Oikarinen (2007) shows that the positive linkage between housing markets and other financial asset markets strengthen economic cycles in Finland. According to the study, it is likely that simultaneous co-movements in equity and housing prices contributed significantly to the deep recession in the early 1990s. Yet, as the capital markets have globalized, while the housing markets are mainly driven by the local forces, the positive linkage between the two asset categories has weakened over time.

In their study, Kuosmanen and Vataja (2002) examine the impact of key macroeconomic variables, such as interest rates, GDP, and inflation, on the Finnish housing and stock markets. The authors use quarterly observations from 1987 to 2000 and find that housing price fluctuations correlate most (0.65) with GDP. This finding is statistically significant contrary to the correlation with inflation and interest rates. Moreover, Granger's causality test shows that the housing market is found to anticipate changes in interest rates and not the other way around. Furthermore, Oikarinen (2007) argues that dwelling price movements can sometimes even create macroeconomic cycles. As the housing market plays an important role in economic policy, the interest in the economic impact of the housing market has increased notably in recent years (Oikarinen, 2011, p. 143–145).

Studying real dwelling price changes in 130 metropolitan areas, Jud and Winkler (2002), find that price appreciation of dwellings is strongly linked to building costs, interest rates, appreciation of stock prices as well as shifts in population and real changes of income. The authors conclude that macroeconomy is certainly interrelated with the dwelling market. In addition, housing price fluctuations have a significant impact on the construction industry. Analysing three small open economies, Sweden, Norway, and the United Kingdom, Bjørnland and Jacobsen (2010) find using structural value at risk (VAR) that the rising housing prices stimulate dwelling construction. Thus, the authors suggest that shocks in housing prices might affect the real growth and finally consumer prices, which, in turn, makes dwelling prices a significant forward-looking factor.

Land use regulations are key determinants of cities' physical development, form, and housing costs. While land prices are directly influenced by the regulations through the costs of permitted uses, land use regulations also have an indirect effect on the prices by creating cities and neighborhoods of a certain type. (Kok, Monkkonen & Quigley, 2014.) Glaeser, Gyourko, and Saks (2006) emphasize that residential construction is vital for urban and regional development. Stagnated housing supply limits the labor force, hindering the expansion of the businesses in the area. Moreover, the authors underline that because of the durability of the buildings and other infrastructure, urban populations abate slowly. Hence, the physical structure of the place also mediates the future development of the region's economy.

The housing market differs from other commodity markets due to its special features. For instance, housing is often one of the largest expenditures for households, as it is an exceptionally expensive commodity. The price of a dwelling is affected by its qualitative features, such as age, condition, environment, and location. (Corradin, Fillat & Vergara-Alert, 2013; Adair et al., 2000; Laakso, 2000.) Furthermore, dwellings vary by size, type, quality, and characteristics. As each property differs from the other by at least the location, each housing is unique, which brings us to the second special feature of the market; heterogeneity. (Laakso & Loikkanen, 2004, p. 241.) Moreover, the housing

market is characterized by high transaction costs, which refer to contract costs, costs of preparation, and implementation for both parties of the agreement. In addition, costs are caused by apartment search, moving, and renovating. Therefore, households change homes relatively seldom. (Corradin et al., 2013; Laakso, 2000.)

It may be considered that a dwelling's price is formed of two different factors; site value and the physical structure value (Oikarinen, 2007; Lönnqvist, 2015, p. 28). The characteristics of the housing and its location determine the price that a willing purchaser is prepared to pay in the market (Agostini & Palmucci, 2008). Even though the price is strictly linked to the dwelling's features, they are not priced separately. Hence, the dwelling has only one price in the market. (Laakso & Loikkanen, 2004, p. 254; Oikarinen, 2007.) In this thesis, terms *housing* and *dwelling* refer to the entity comprising of land and physical construction value.

Although the built environment accounts for nearly three-quarters of Finland's national wealth, there is a relatively limited empirical evidence on the housing price dynamics in the country. In addition, Oikarinen (2007) argues that the existing studies often fail to analyze countries as one homogeneous housing market although there may exist several distinct housing markets within a country, which is also the case for Finland, for instance. Since the early 1990s, the migration of Finland has centered from peripheral areas to the Helsinki Metropolitan area (HMA) and other growing cities, such as Tampere, causing the housing price development to diverge regionally (Laakso, 2000). As noted, the Finnish housing markets are notably localized and, therefore, national level data may not be applicable as it ignores the economic differences between regions.

The purpose of this study is to assess the implications of the co-movement between macroeconomic variables and housing price development of the HMA. The selected region of focus is the HMA, as it is the capital region of Finland and, also, an economically important area for the country. As noted, the housing prices in the HMA have been rising for many decades due to the strong demand causing dwelling price development to

diverge to an even larger extent from the development of the rest of Finland. Moreover, the attractiveness of this area does not seem to be declining even though the housing prices and rental levels are higher than elsewhere in Finland, making the HMA an interesting region to focus on.

1.1   Housing in the Helsinki Metropolitan Area

The HMA comprises of the capital city Helsinki and the neighboring cities of Espoo, Vantaa, and Kauniainen. Having a population of ca. 654,000, Helsinki city is the largest municipality in Finland, followed by the city of Espoo. Table 1 below demonstrates the population and housing statistics of cities of the HMA. According to Table 1, the total population of the HMA was ca. 1,187,000 by the end of 2019, which accounts for 21.4% of Finland's population. (Official Statistics of Finland, 2020a.) Interestingly, the HMA also accounts for solely 0.4% of Finland's total acreage, suggesting that the population of Finland is extremely centered on the capital region (National Land Survey of Finland, 2020).

Table 1. Population and dwelling statistics of the HMA (National Land Survey of Finland, 2020; Official Statistics of Finland, 2020a & 2020b).

City	Population 31.12.2019	Land Area, km²	Population Density per km²	Dwelling Units	Household-Dwelling Units	Average Size of Household-Dwelling Unit	Price per sqm
Helsinki	653,835	214	3,052	371,295	339,786	1.9	4,323
Espoo	289,731	312	928	139,518	129,908	2.2	3,293
Vantaa	233,775	238	981	120,755	111,348	2.1	2,661
Kauniainen	9,797	6	1,663	4,539	4,106	2.4	3,801
Total HMA	**1,187,138**	**771**	**1,540**	**636,107**	**585,148**	**2.0**	**3,520**

Table 1 above shows that there are notable differences in the number of dwelling units, acreages, and population densities between the cities of the HMA. The number of dwellings is clearly the highest in Helsinki, whereas, in Kauniainen, there are solely ca. 4 100 dwellings. However, the average size of a household-dwelling unit of Kauniainen is notably larger than in the other cities of the HMA suggesting that the area is more populated by the bigger households. However, contrary to the general perception, families with children have shown to prefer urban areas to suburban in recent years. The growing number of families with children in the HMA contributes to the housing shortage and the increasing housing demand of the area. (HYPO, 2019b.) Even though over 49% of the total households in Helsinki were households of one at the end of 2019, the number has decreased over the last decade, as the number of larger households has increased (Official Statistics of Finland, 2020g; HYPO, 2019b). Still, a typical feature of the housing of Helsinki is a large number of small dwellings reflecting to the smaller average household-dwelling unit compared to other cities of the HMA, as presented in Table 1 above.

Studying the relationship between Finnish housing prices and GDP at a regional level, i.e., Helsinki, Espoo, Vantaa, Turku, Tampere, Lappeenranta, Oulu, and Kuopio, Kuosmanen and Vataja (2002) provide evidence that housing prices are dependent on the GDP. Moreover, the Granger causality tests give indications that stock and housing markets anticipate the development of the GDP. Also, the regional analysis reveals that the shocks in stock markets are transmitted to the housing markets first through the prices of small apartments in the HMA from where the effect spreads further to larger apartments and regionally to the rest of the country. As small apartments are the most common housing investment targets, the finding seems reasonable.

The HMA benefits from urbanization, and during the last ten years, the population growth has been positive. The annual population growth rate has been 1.12% in Helsinki, 1.68% in Espoo, and 1.67% in Vantaa, all exceeding the national average of 0.28%. The population of the HMA is expected to grow by 11.6% to ca. 1,320,000 by 2030, and

further to ca. 1,395,000 by 2040. (Official Statistics of Finland 2019a & 2019b.) DiPasquale and Wheaton (1996, p. 58) argue that the key driver of housing prices is, in fact, the population growth rate of a city. Furthermore, the authors state that the faster the population growth is, the higher the housing prices and rents tend to rise.

The population movements in Finland are not only stimulated by the high unemployment rate in rural regions forcing the labor force to move towards the more urbanized areas but also due to the increasing number of student places and other conveniences provided by the larger cities and areas, such as the HMA. Therefore, it is notable that increasing housing prices in the HMA are mainly demand-driven. However, the HMA has geographical constraints as the area is bounded by the Baltic sea, as can be noted from Picture 1 below. Moreover, the building is also relatively tightly restricted in the area, causing the inelasticity of housing supply in the area. (Oikarinen, 2007.)

Picture 1. The Helsinki Metropolitan Area.

According to Holappa et al. (2015), urban population growth poses a challenge, especially to land use design. Even though the size of the city itself affects the flexibility of land supply, it can also be influenced by the pursued land policy. Studying the relationship between the land use regulation and property prices in the San Francisco Bay Area, Kok et al. (2014) find that the more complex the zoning change or a building permit process is, the higher the property prices are. Moreover, Glaeser, Gyourko, and Saks (2005) argue that in many markets, housing prices are high due to restrictive zoning regulations as they hinder the construction of new dwellings in the area. In addition to the cities' own decisions, the roles of state regulation and taxation are central in meeting the challenges of urbanization (Holappa et al., 2015).

Haurin (1991) provides evidence that the higher the income expectations of the households are, the stronger the demand for housing is. The study shows that the income elasticity of the housing prices is 0.78. Moreover, Oikarinen (2005) finds that income levels and expectations of future income development have a statistically significant impact on the housing prices in the HMA. According to the Official Statistics of Finland (2018a), the average income per year in the HMA was €31,215, while the average of Finland was €29,540. As the income levels are higher in the HMA compared to the rest of Finland, it can be assumed that, correspondingly, the housing prices are higher in the HMA than elsewhere in Finland.

One of the recent trends in the housing market is the explosive growth of residential construction, as can be detected from Figure 1 below. Economic growth, urbanization, low interest rate levels, and strong investor demand led to a boom in construction. Since 2013, the amount of granted construction permits have experienced radical growth reaching its peak in 2017. As is illustrated in Figure 1 below, during this 4-year period, the number of granted building permits increased from ca. 7,000 to nearly 18,000 in the HMA solely. However, the number of permits started to reduce at the beginning of 2018. As housing production is connected to the number of construction permits granted, the outlook for the residential construction for the next few years has decreased due to the

reducing building permit levels. (Confederation of Finnish Construction Industries RT, 2019.) Provincial centres, and in the HMA, Espoo, and Vantaa have generated the biggest growth in the residential construction of Finland, whereas the development of Helsinki has been relatively slow for years. The stagnated construction in Helsinki is mainly due to prolonged inadequate zoning and site transfer. (HYPO, 2019a.)
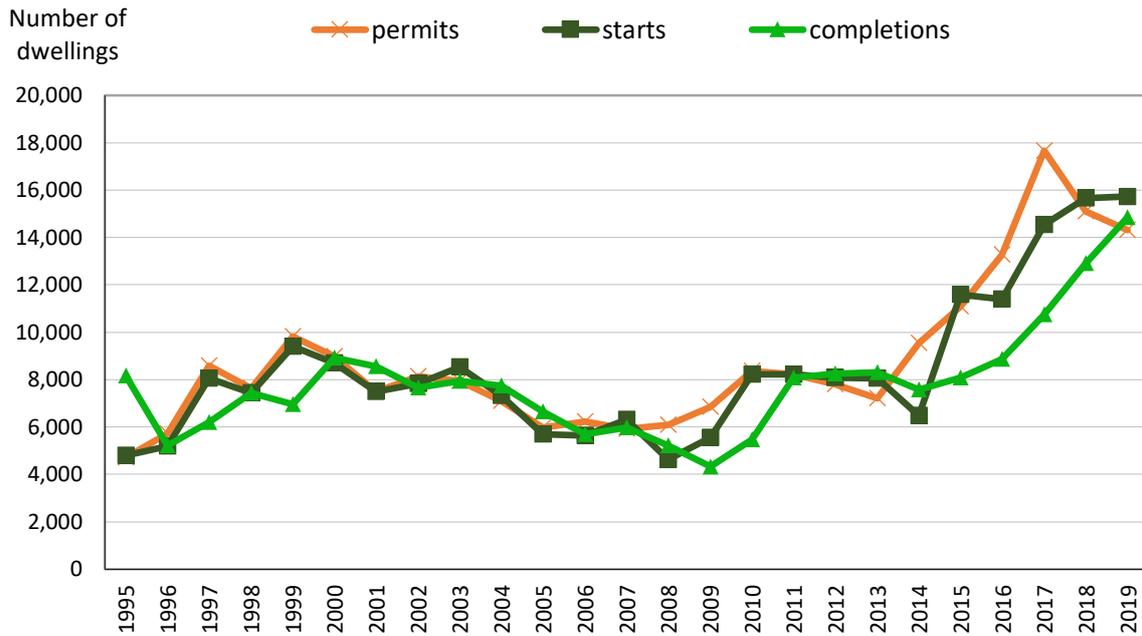
Figure 1. Residential construction activity in the HMA from 1995 to 2019 (Official Statistics of Finland, 2020c).

Even though the amount of granted construction permits is moderately slowing down, according to Figure 1 above, the construction levels are still higher than ever in the HMA during the examined time period. Moreover, a record-breaking number of new residential buildings is still under construction in the area. Growing housing supply controls the pressure for housing price and rent level increase on old apartments in the HMA. Steady economic growth and low interest rates are supporting the demand in construction, yet, the number of dwelling start-ups is expected to return from recent years record-breaking numbers back to the average levels. (Confederation of Finnish Construction Industries RT, 2019; KTI, 2019.)

The housing price development in Espoo and Vantaa has remained under control due to an abundance of construction, whereas dwelling prices in Helsinki are still increasing. The strongest demand focuses on the city center of Helsinki, where the housing supply lags in particular due to the weak use of land. (HYPO, 2019a.) Several studies (see e.g. Gyourko, Saiz & Summers, 2008; Ihlanfeldt, 2007; Green, Malpezzi & Mayo, 2005) show that low-density zoning in particularly hinders the elasticity of housing supply in local markets forcing dwelling prices to rise. Therefore, to increase the housing supply, researchers encourage cities to higher-density construction development, especially in suburban areas, which are typically zoned for low-density family houses (Talen & Knaap, 2003).

1.2 Research question

Several studies (see e.g. Krumm, 1987; Reichert, 1990) identify significant regional differences in the impact of macroeconomic variables, such as interest rates, income level, and demographic factors. Recently, the Finnish housing market has raised interest among researchers, yet, the amount of studies is still relatively limited. Also, the existing studies focus mainly on finding a possible housing bubble (Oikarinen, 2005) or forecasting the changes in the housing stock (Huovari et al., 2002) rather than on the long-term housing price formation. Especially the need for regional research is inevitable as the Finnish housing prices have clearly diverged over the last decades.

The purpose of this paper is to detect the main macroeconomic factors that move correspondingly to the housing price development of the HMA and, moreover, to evaluate the significance of the co-movements between the explanatory variables utilized in the ordinary least squares (OLS) time series regression and the development of housing prices of the HMA. The aim is to find a connection between the macroeconomic variables and housing price development in the HMA and to study the implications of the variables. The selection of macroeconomic variables is based on

previous studies, as these variables, in general, describe the development of the economy and, thus, the housing market. In this study, the macroeconomic factors that are used as explanatory variables are GDP, inflation, unemployment rate, building cost index, interest rate, household debt variable, and stock market index. It is notable that although the purpose of this study is to analyze the housing price development at a regional level, the macroeconomic variables that are utilized as explanatory variables in the OLS regression are national. The limitations that arise from the usage of national level data are considered in the empirical part of the study.

1.3   Structure of the thesis

The theory part of is study is based on a comprehensive literature review. To begin with, the development of the Finnish housing markets over the last few decades is introduced. After that, the housing price dynamics and the previous studies, and their key findings on macroeconomic factors impacting the dwelling prices are presented. Furthermore, this study contains an empirical research part, where the data and methodology utilized in this study are described. The empirical part also comprises of the interpretation of the findings. The aim is to link the empirical results to the existing scientific literature while taking into account the special regional features of the HMA when concluding the results of the OLS time series regression.

This study is structured as follows. To begin with, the development and structure of the Finnish housing market are described, followed by the introduction of the outlines of financial liberalization and its effects on the Finnish housing market. The subsequent chapter consists of presenting the dynamics of the housing prices with the four-quadrant model. In addition, the housing prices are observed from both microeconomic and macroeconomic perspectives. The same chapter also includes the presentation of the previous studies regarding the main macroeconomic variables, such as GDP, interest rate, inflation, and the stock market, and their impact on housing prices. The findings of the

previous literature are also utilized as a base for the analysis of the empirical results. Next, the data and methodology utilized in this study are described, followed by the empirical analysis part, which comprises the interpretation of the results. Finally, conclusions will finish the thesis.

2   Structure of the Finnish housing market

In this chapter, the development and current structure of the Finnish housing markets are presented. Due to the importance of housing on the overall economy as well as on households' welfare, the public sector intervenes in the activity of the housing markets all over the world, and Finland is not an exception to that. However, during the past decades, the Finnish housing market experienced drastic institutional changes, such as deregulation in the late 1980s, which had a notable impact on the housing market at the time. First, the history and development of the Finnish housing market are presented. To finish the chapter, the current situation of the Finnish housing market is described concerning housing taxation, construction, and rent levels. Also, the outlook of the Finnish housing market is briefly discussed.

2.1   Development of the Finnish housing market

The Finnish housing market experienced drastic changes nationally and regionally during the 1980s and 1990s. Housing prices and the production of housing increased significantly in the late 1980s and then again collapsed in the early 1990s. These events can be largely explained by the development of employment rate, income, interest rates, and the proportion of empty houses. The liberalization of financial markets resulted in a rapid increase in housing prices, and, interestingly, there is no evidence of a housing price bubble. The boom of the housing construction resulted mainly from the housing price development. (Laakso, 2000.)

Muellbauer and Murphy (1997) and Kosonen (1997) detect a significant effect of financial constraints and the tax code on the housing prices. Several studies on the Finnish housing market (see e.g. Oikarinen, 2005; Kosonen, 1997) show that only after the financial deregulation, the real interest rates became influential to the dwelling prices. To strengthen, Muellbauer and Murphy (1997) detect similar results when

studying the housing prices in the United Kingdom. According to their study, the housing prices in the UK became more responsive to real interest rates and the expectations of income growth after the country's financial liberalization in the early 1980s.

The liberalization of financial markets in Finland happened gradually, similarly to several other industrialized countries in the late 1980s (Laakso, 2000). Before the deregulation, interest rates were strictly regulated. As a result, the real interest rates were negative, and credit was rationing. (Saarimaa, 2010.) Additionally, the past credit control was subject to strict ex-ante saving requirements and, thus, after the liberalization, the access to credit and mortgages became much easier, especially for middle-class households. Moreover, the situation in the bank sector changed completely as the competition between banks intensified. Mortgage rates began to be generally tied to the market-based rates, and, correspondingly, the importance of previous administratively determined interest rates decreased. As a result, the dependency on household loans' interest rates on international financial markets increased. Simultaneously, as the inflation slowed down considerably, the new changes indicated that households real interest rates on loans turned permanently positive, unlike in the 1970s and early 1980s when real interest rates were mainly negative. Hence, the liberalization had a significant impact on the Finnish housing market. (Laakso, 2000.)

Figure 2 below represents the housing price development of old dwellings from 1988 to the end of 2019 by regions, i.e., the HMA, the rest of Finland, and Finland as a whole. The basic development trend of the Finnish housing market was relatively consistent until the early 1990s (Laakso & Loikkanen, 2004, p. 277). The recession began at the beginning of the 1990s and affected the whole of Finland as the increased unemployment led to a reduction of housing demand. As a result, the housing prices fell notably in all areas, as illustrated by Figure 2 below. According to Laakso (2000), the drop was also a consequence of the housing production boom, as the housing supply exceeded the demand. Also, increased uncertainty of the stock market contributed to the housing price decrease. Prices continued to fall and were down to a record low in

1992, as presented in Figure 2 below. The next year, housing prices increased slightly but, then again, fell back to the 1992s figures, mainly due to the increasing interest rates and the reduced right of housing loan interest deduction. Housing prices started a new long-run increase at the beginning of 1996, as shown in Figure 2 below.
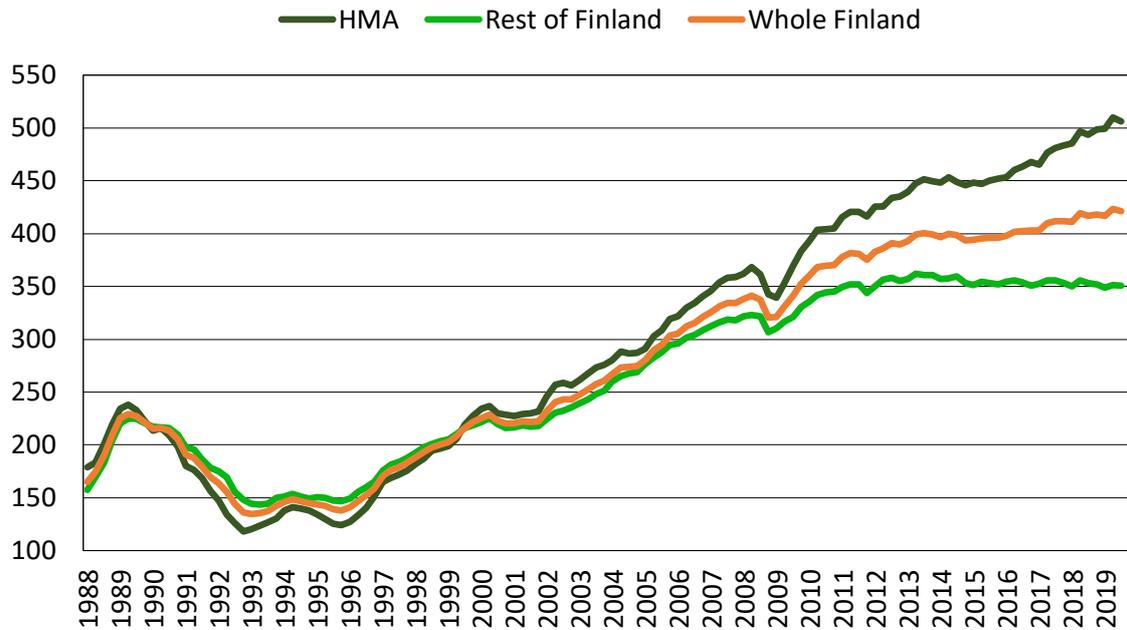
Figure 2. Housing price development of old dwellings (index 1983=100) by region (Official Statistics of Finland, 2020b).

According to Figure 2 above, the regional differentiation of the Finnish housing market started to become more detectable since the beginning of the 2000s. The financial crisis caused a significant drop in the housing price growth in 2008, yet, the decrease continued only for nearly a year (Kivistö, 2012). Since the drop, the price growth has slowed down in the rest of the country, as presented by Figure 2 above. Yet, the housing prices in the HMA continued increasing at a brisk pace. According to Figure 2 above, the housing market in the HMA has clearly diverged from the rest of Finland regarding housing price development. Even though the housing prices are high also in the other growth centres in Finland, the prices have increased the most in the HMA (Holappa et al., 2015). Furthermore, the regional differences also concern types, sizes, and qualities

of dwellings. Partly for this reason, the household's wealth and debt distributions vary not only between socioeconomic groups but also region-wise, affecting households' consumption opportunities and well-being. (Laakso, 2000.)

The migration to the HMA increased significantly already during the recession. At the time, the increase was initially due to immigrants but, quickly after the recession, also, the domestic migration to the HMA and other growth centres increased. The migration was primarily work-induced, and, for instance, from 1975 to 2000, the unemployment rate in Helsinki was on average one percent lower than elsewhere in Finland. (Laakso, 2000.) Studying the demographic changes in the HMA from 1962 to 1997, Kuismanen, Laakso, and Loikkanen (1999) show that one percent increase in the demographic demand variable, which is based on the age statistics of the population of the HMA, results in a 0.2% increase in the real housing prices of the area. Similarly, Oikarinen (2005) states that in the long run, the housing price development is strongly dependant on the demand factors. In addition, the author finds that real growth of disposable income, together with falling real interest rates, largely explains the price development until the mid-2000s, yet, the effect of real interest rates became significant only after the deregulation. While the residential indebtedness has continued growing among those living in Finnish growth centres, the development of housing value has continued its decrease in declining localities, causing a fall also in the area's homeowners' wealth (Karikallio et al., 2019).

As noted, the Finnish housing market is closely connected to the macroeconomic changes. The real estate sector is prone to cyclical fluctuations, especially due to the short-term inflexibility of the housing supply. Because of the supply inelasticity, changes in the demand-side cause strong housing price fluctuations, which, in turn, affect the construction sector. Also, both housing production volume as well as construction costs follow closely housing price development. (Laakso, 2000.) However, according to Holappa et al. (2015), the rise in housing prices in Helsinki has continued for nearly a decade longer than macroeconomic reasons justify. Because the criteria for bank lending

have tightened rather than loosened, households' dwelling purchasing does not explain this housing price development. In addition, the uncertainty about the future development of household earnings has led many households to stick to rental housing. In recent years, however, the importance of housing investors has increased significantly and, currently, the residential construction activity is, for the most part, upheld by the strong investor demand (KTI, 2019).

The housing market in Finland can be divided into two categories, i.e., privately financed housing and subsidized housing. While the privately financed housing can be traded at market prices without any restrictions, selling and rental prices of subsidized housing are publicly regulated. Although this thesis focuses on the privately financed sector, the subsidized market is worth discussing as it affects the volume, prices, and rent level of non-subsidized housing stock as well. (Oikarinen, 2007, p. 57.) More exact, DiPasquale and Wheaton (1996, p. 18–19) show that subsidized construction lowers the demand for non-subsidized rental units. Furthermore, Nordvik (2007) provides evidence that the construction of subsidized housing decreases the prices of privately financed housing. Yet, the effect weakens as the supply elasticity of non-subsidized housing grows.

Residential construction in Finland has been extremely active in recent years. Housing production focuses on areas of high demand, i.e., mainly in the HMA and other growing cities, such as Tampere. (HYPO, 2019a.) Table 2 below describes residential building start-ups in Finland by dwelling types from 2015 to 2020. All of the values are realized except for the year 2020, where the values are estimated. Housing production started to become more active since 2015, and, as presented by Table 2 below, over 40,000 new homes were built in Finland in 2017, surpassing the milestone for the first time since 1991 (HYPO, 2019a). Housing production peaked in 2018 when the construction of over 45,600 new dwellings was started. However, since then, the construction activity has clearly slowed down. In 2020, start-ups are expected to decrease to ca. 32,000 apartments, which is a bit under the 21st century's average. As Table 2 below reveals,

construction focuses primarily on multi-storey buildings and, more specifically, in small apartments. (Confederation of Finnish Construction Industries RT, 2019; KTI, 2019.)

Table 2. Residential building start-ups in Finland (Official Statistics of Finland, 2020c; The Housing Finance and Development Centre of Finland, 2020a & 2020b).

Dwelling start-ups, amount	2015	2016	2017	2018	2019	2020
Multi-storey buildings	22,100	26,400	32,700	34,400	27,300	21,600
Non-subsidized dwellings	13,600	18,500	24,100	25,800	19,800	12,600
ARA subsidized dwellings	8,500	7,900	8,600	8,600	7,800	9,000
Row houses	3,300	3,400	3,800	3,500	3,300	3,200
Detached houses	6,500	6,700	7,400	7,200	6,900	6,700
Other buildings	600	700	600	500	500	500
Total	**32,500**	**37,200**	**44,500**	**45,600**	**38,300**	**32,000**
Non-subsidized dwellings	24,000	29,300	35,900	37,000	30,500	23,000
ARA subsidized dwellings	8,500	7,900	8,600	8,600	7,800	9,000

The decrease in housing production is linked to the amount of granted construction permits. After the number of permits started to reduce at the beginning of 2018, the residential construction in Finland has decreased in the following years as Table 2 shows. The construction is still abating everywhere in Finland except the HMA area. Due to an abundance of housing production, Finland has managed to avoid a bounce in housing prices. (Confederation of Finnish Construction Industries RT 2019.)

One of the most notable housing trends over the last decade has been the growth of households of one. In Finland, there are nearly 1.2 million single living households, which accounts for 45 percent of the total household-dwelling units in Finland. In addition, the medium size of Finnish household-dwelling units decreased to 1.99 in 2018, which was the first time in Finnish history that the number fell below 2 and continued decreasing to 1.97 in 2019. (Official Statistics of Finland, 2019c & 2018b). The increase in the number of households and the decrease in the average size of a household-dwelling unit

reflects to the growing demand for housing and, especially, demand for small apartments. Due to the increasing demand, the prices of studio apartments have risen since 2008 in relation to larger dwellings and, furthermore, the average size of new dwellings has decreased. (Ristimäki et al., 2017.)

Further demographic examination reveals that the number of Finnish single living households has grown in particular among younger people and the elderly (Ristimäki et al., 2017). During the last decade, the number of people aged 70 to 74 living alone has grown by 55 percent. Moreover, nearly half of people aged over 75 live alone in Finland. This phenomenon can be partly explained by the fact that the number of people of this specific age group has grown by 74,000 since 2009. In relative terms, single living has also grown by 27 percent amongst the population aged under 30. The change in housing benefit in 2017 seems to be closely linked to the growth as the number of households of one among the young people grew, especially after the modification. (Official Statistics of Finland, 2019c.) To strengthen, Laakso (2000) states that support and regulatory systems of the housing sector have a significant impact on households' housing costs and, hence, the housing market. As the proportion of elderly is increasing, the future development of household sizes is expected to continue its current decreasing trend (Ristimäki et al., 2017).

2.2   Current situation in the Finnish housing market

While housing is generally considered to be a necessary commodity from a consumer's perspective, it also plays an important role as an investment that generates stable cash flow. Especially communities whose responsibilities are spread for decades onward, such as pension or insurance companies, are interested in inflation protection as well as the above-mentioned stable cash flow. This chapter presents the Finnish housing market as of its current state, focusing on the housing market as a part of the national wealth. This

chapter also discusses the housing taxation, construction, and rent levels, as well as the current conditions and outlook of the Finnish housing market.

There are several special features in housing that need to be considered in the planning of housing taxation. For owner-occupied housing, the apartment is simultaneously a durable good as well as an investment. Therefore, housing can be conceived as a capital good that produces consumer goods, i.e., housing services. For this reason, housing taxation should be viewed from both consumption and capital income taxation perspectives. In Finland, new construction is subject to value-added tax (VAT), and the exchange of dwellings is subject to capital transfer tax, excluding first-time homebuyers under the age of 40. The transfer tax increases the moving costs for homeowners and trading costs for investors. The tax constitutes a wedge between the buyer's willingness to pay and the seller's price desire. For the realization of the housing transaction, the buyer's willingness to pay must be at least a tax worth of higher than the seller's price desire. Transfer tax can reduce the number of housing transactions and, therefore, cause loss of welfare of the households. (Eerola, Lyytikäinen & Saarimaa, 2014; Gervais, 2002.) According to Lyytikäinen (2013), a one percent increase in transfer tax can reduce the number of home sales by 10 to 20 percent in Finland. As the reduction of sales is significant, the disadvantage of a transfer tax is large in relation to the tax revenue.

Additionally, the landlord's rental income is taxable on capital gains tax. However, the landlord's expenditures on the house, as well as the interest on the housing loan, are tax-deductible. Since 2012, the right to deduct interest on owner-occupier's mortgage loan has been progressively limited. Hence, the tax treatment of the landlord and the owner-occupier is different. Also, income from owner-occupied housing is taxed less heavily compared to the returns from other investments. (Eerola et al., 2014.) In other words, taxation encourages households to choose owner-occupied dwelling over a rental apartment, and, also, invest in housing instead of other asset classes. Yet, because of the credit constraints, the acquisition is not possible for everyone as it requires a share of self-financing. Hence, taxation encourages to start saving at a young age. (Gervais, 2002.)

Large real estate investors, such as pension companies, are important to society for numerous reasons. Firstly, they build a society by financing the construction of a new housing and office stock, also, when access to capital from other sources may be difficult. In addition, large professional investors maintain and develop their properties systematically, maintaining the value of national wealth. Moreover, large investors are important to society as providers of long-term investment capital. They can also increase the stability of the domestic capital markets and, for example, counteract cyclical fluctuations as the domestic investments contribute to the production capacity and employment of a national economy. (Rakli, 2014, p. 40–41.) In fact, residential construction activity in the Finnish growth centers is mainly supported by the strong investor demand at the moment, as the demand from private investors and homeowners is abating from their top levels. Especially in the HMA, the construction activity is expected to slow down moderately. (KTI, 2019.)

As noted, the importance of housing investors has increased significantly in recent years. To safeguard the pension income for current and future pensioners, pension fund investors need to obtain enough long-term returns on their investments. In general, investor behavior is determined by the investment return and the alternative return on investment of a similar risk level. Government debt securities, for example, can be considered as an alternative investment target for housing investment. Even though the government loans are less risky, their current and expected yields are exceptionally low, raising interest in housing investment. Moreover, interest in real estate investing continues strong because of the low interest rates and stable returns. (Holappa et al., 2015.)

In Finland, pension companies own more than 12 billion euros worth of direct real estate investments. Besides the direct investments, pension companies are also a significant indirect real estate investor. For instance, Ilmarinen and Varma are amongst SATO's and VVO's shareholders, and most unlisted real estate funds invest institutional investor's assets. (Rakli, 2014, p. 40–41.) The conditions in the Finnish residential investment

market have also attracted foreign investors to the market, who have increased their visibility in recent years. To be exact, at the end of the year 2019, foreign investors held ca. 15,000 rental apartments. The net yield of dwellings has increased slightly due to higher rental income and high occupancy rates. The positive development is expected to decline when interest rates start to rise, and the growth of rental income slows down. (KTI, 2019.)

When studying the rents, it is notable that the prices of the dwellings are strictly linked to the rent level in the long run. Assuming that the price-to-rent ratio remains stable, the increase in dwelling prices lifts the rental levels correspondingly. Hence, the growth in the value of owner-occupied dwelling does not improve the household's consumption possibilities as selling the house and moving to a rental apartment would not affect the value of the discounted cash flow. (Oikarinen, 2011, p. 134.) Figure 3 below represents the average residential rents in major Finnish cities, and the values are taken from the last quarter of 2019.
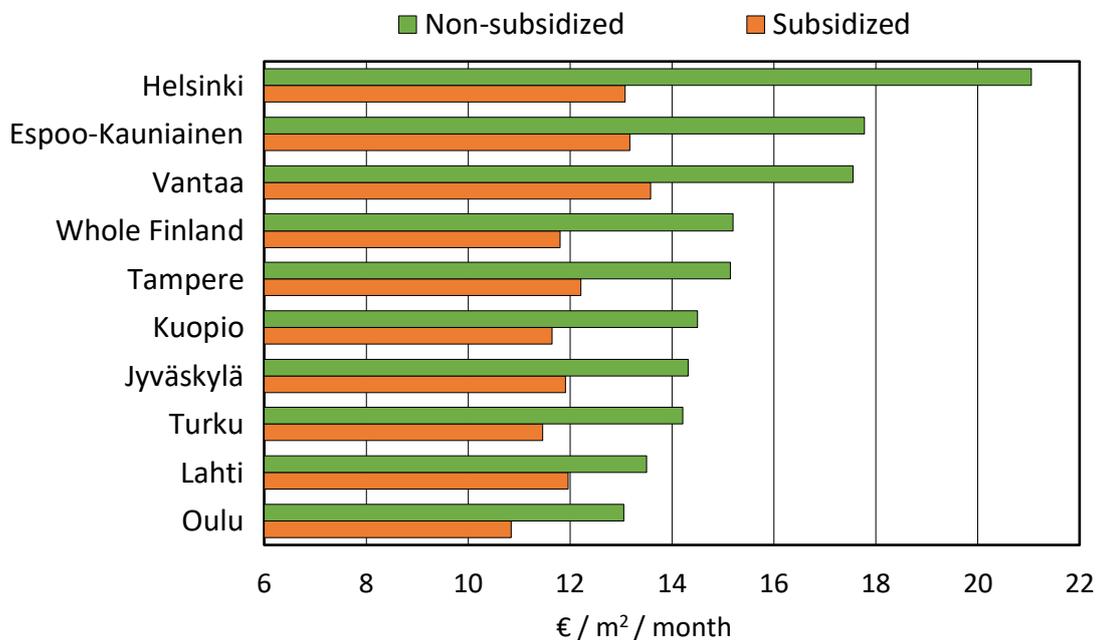

Figure 3. Average residential rents in Q4/2019 (Official Statistics of Finland, 2020d).

As can be detected from Figure 3 above, the rental levels are significantly higher in the HMA and, especially in Helsinki, compared to other Finnish cities. While the average non-subsidized rent in Helsinki is €21.05 per square meter per month, the same price for a rental apartment in Oulu is €13.06. Thus, the regional rental price difference between the two cities is over 60%. Due to the strong linkage between the dwelling prices and rental levels in the long run, Figure 3 suggests that the dwelling prices must be higher in the HMA compared to other Finnish regions (Oikarinen, 2011, p. 134). In the HMA, residential rents rose by 3.3 percent from September 2018 to September 2019 and, interestingly, rents increased slightly more in Vantaa and Espoo compared to Helsinki. During this one-year period, residential rents rose by 2.4% on average also, in other major cities of Finland, the most in Turku and Tampere. (KTI, 2019.)

According to Holappa et al. (2015), in recent years, the rents in Finland rose faster than housing prices or tenants' incomes. Moreover, the authors state that uncertainty of future employment development and tighter bank lending conditions explain the demand for the cyclical growth of rental housing. On the supply side, the area of concern is the weak development of new production of subsidized rental housing, which also reflects to non-funded rent development. According to the Official Statistics of Finland (2020f), residential rents in Greater Helsinki increased by 6.8% on average since 2015 and the rest of Finland by 5.5%. Moreover, despite the recently occurred rapid growth of housing supply, the rents are expected to continue increasing in all major cities of Finland, yet, the annual growth rates have clearly shown signs of slowing down (KTI, 2019).

3 Theoretical background

The theoretical part of the study introduces the reader to the importance of the housing market and elaborates on the nature of dwellings as commodities. The theory section describes the key factors in the dwelling price formation and explains how they affect the housing prices. Moreover, the chapter discusses housing and housing markets through microeconomic and macroeconomic perspectives. Subsequently, the findings of previous studies on the relationship between the main macroeconomic variables and housing prices are reviewed. The key focus is on those macroeconomic factors that are used as the explanatory variables in the analysis part of this study.

3.1 Housing price dynamics

Housing covers a significant part of household wealth, and housing costs make up a significant proportion of household consumption. Additionally, dwelling prices affect the rest of the household consumption. (Oikarinen, 2011, p. 128.) Fair (1972) detects three different groups in his study which operate on housing markets and whose decisions and actions determine the future development of housing prices. The first group consists of people who apply for mortgages for a house acquisition. People of the second group build new houses and repair the old ones. The last group includes people who reinvest their resources so that the first group can receive a loan for housing purposes.

The economics of housing prices can be described with two categories: long-term and short-term determinants of demand and supply. The long-term supply of housing is influenced by the profitability of land ownership, together with the existing housing possibilities and the potential improvements therein; the renovation costs, and the enhancement of quality. The factors that affect the long-term demand, on the other hand, are increased household income, the changes in demographics, the tax system's evolving characteristics that steer the trend of owning a house as opposed to other

alternatives. Also, given that purchasing a house typically demands external financial support, interest rates and the mortgage finance markets play an important role in the development of housing prices because of the cost of the mortgage credit. (Tsatsaronis & Zhu, 2004.)

As previously noted, households are the consumers in the housing markets. Thus, the demand for housing is affected by the population changes. During a positive economic cycle employment rate, household income and migration increases, which, in turn, elevates the housing demand. (Laakso & Loikkanen, 2004, p. 243–244; Laakso, 2000; Kuismanen et al. 1999.) Studying the housing prices in 62 US metro areas, Capozza et al. (2002) provide evidence that a one percent increase in population results in a 0.15% growth in dwelling prices in the long run. Also, Gyourko et al. (2013) analyze the USA's housing market from 1970 to 2000 and find that two-thirds of the dispersion growth of housing prices can result from the increase in the number of high-income households.

The demand for housing can stem from the households as well as from the investors and, moreover, the demand of households can be divided into rental and ownership demand. The distinction between the two is clear, especially in the case of rental demand where the housing consumption and possession are separated. (Laakso & Loikkanen, 2004, p. 267.) In Finland, taxation encourages households to choose owner-occupied dwelling over a rental apartment. However, the homeownership is not possible for everyone because of the credit constraints, as the acquisition requires a proportion of self-financing. (Gervais, 2002.)

When investigating the housing supply, the most significant factor is changes in dwelling stock. The net change of dwelling stock is determined by construction as well as the demolition of dwellings and shifts in their usage purposes. The factors affecting the housebuilding include zoning, politics, and taxation. Additionally, the regulation plays an important role in housing supply elasticity. Higher levels of the regulation stall the construction of new dwellings leaving the population levels and, therefore, the urban

development relatively unchanged. Also, the increase in available housing may be limited due to area planning or upcoming constructions. When housebuilding lags from the housing demand, housing prices are pressured to increase. (Glaeser et al., 2006; Laakso & Loikkanen, 2004, p. 244–247; Tsatsaronis & Zhu, 2004.)

Gyourko, Saiz, and Summers (2008) find that, on average, it takes six months to secure an authorized construction permit for a construction project in the United States. After the permission is granted, the average length of time of the construction completion varies between six to 12 months, depending on the size of the building. Poor adaptability of housing supply is a burden not only on households but on businesses and municipalities as well and, hence, on the regional development and further on the whole economy. Housing supply flexibility has a significant impact through the cost of living on population growth and its structure, income level development, distribution of wealth, migration, and local labor markets. (Glaeser et al., 2006; Gyourko, Mayer & Sinai, 2013.) Glaeser et al. (2006) emphasize that the housing supply is crucial for urban and regional development. Stagnated housing supply limits the labor force, hindering the expansion of the enterprises in the area.

To examine the long-term housing price formation, DiPasquale and Wheaton (1992) introduce the four-quadrant model, which is graphed in Figure 4 below. Even though the model represents the housing price formation in the rental market, the four-quadrant model also applies to the Finnish housing market because the majority of the housing market operators are owner-occupants. The model comprises of four quadrants, where the two right-handed illustrate the housing market from the space use framework, and the two left-handed describe the asset market from the homeownership perspective. The rental level per square meter (R) is illustrated in the vertical axis, while the horizontal axis represents the dwelling stock. The model is in equilibrium when the demand for the dwelling (D) is equal to the supply (S). According to the upper left side quadrant, the capitalization rate (i) is negatively correlated with the housing price level, meaning that the higher the rate i is, the lower the housing prices

(*P*) are. The capitalization rate is affected by the interest rate, the expected increase of rental level, tax treatment, and the rental risk. In the model, *i* is exogeneous, yet, in reality, the rate is influenced by the housing cycles.

ASSET MARKET: Valuation

P=R/i

Price (€/m²)

P=F(C)

ASSET MARKET: Construction

Rent (€/m²)

Construction (m²)

PROPERTY MARKET: Rent determination

D = S

Stock (m²)

S = C/d

PROPERTY MARKET: Stock adjustment
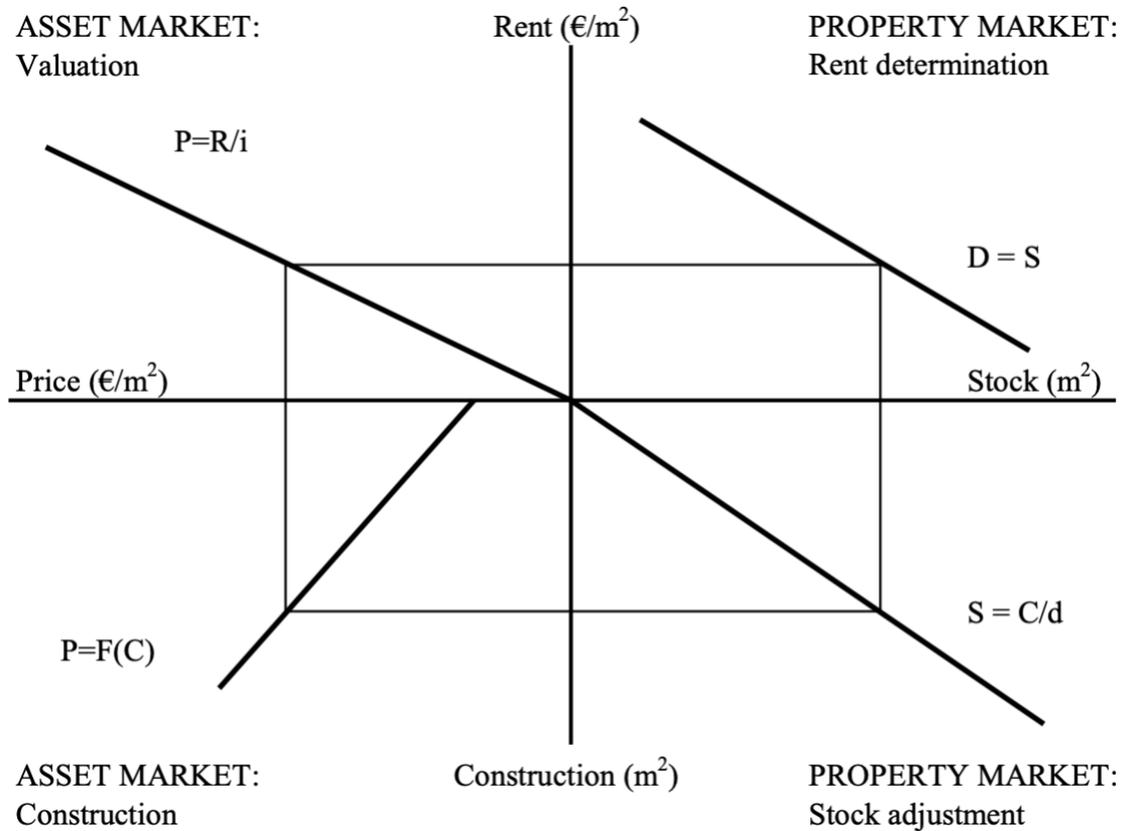
Figure 4. Four-quadrant model (DiPasquale & Wheaton, 1992; Oikarinen, 2007).

The southwestern quadrant of the model presents the new housing construction. The curve f(*C*) illustrates the replacement cost of dwelling. It moves to a southwesterly direction because greater building activity (*C*) is assumed to result in higher construction costs. In the equilibrium state, the price level is equal to f(*C*). The slope of the f(*C*) depends on the input supply inelasticity. As the inelasticity increases, the curve becomes more horizontal. The more horizontal the curve is, the greater the dwelling prices respond to shocks. The southeastern quadrant, on the other hand, represents the long-term dwelling stock. When construction *C* equals the depreciation (*d*) of housing, the long-term equilibrium of the stock is achieved.

Evidently, all quadrants affect each other. Rent level is vital in the determination of asset prices, while the price level has an impact on the construction activity. The construction, on the other hand, affects the housing stock, and, furthermore, the rent prices are dependent on the supply. The equilibrium state of the housing market is achieved when the equilibrium conditions are obtained in each quadrant. Moreover, the long-run equilibrium can be changed by any quadrant. The changes in the population or household income can shift D, whereas the changes in, for instance, the interest rate may result in an adjustment of the housing prices. Also, the increased inelasticity of the input supply can lead to higher construction costs, affecting the profitability of the construction industry. Thus, all of the quadrants are dependent on shifts in one another.

3.1.1 Microeconomic framework

In the microeconomic framework, a house is a consumer durable commodity where the consumers are households. However, housing has special characteristics in comparison with other goods. According to Jin and Zeng (2004), while the annual depreciation rate for consumer goods is 21%, the same rate for housing is 1.5 percent. Therefore, housing stores the value significantly better compared to the other consumer durables. In addition, a dwelling is an unusual commodity due to its spatial fixity, immobility, durability, and heterogeneity. As the surroundings and services are considered in the buying process, housing is also a multidimensional commodity. A house is an expensive commodity consisting of numerous structural, qualitative, and quantitative characteristics. Furnishings and building materials significantly affect the value of a dwelling. In the housing selection process, every household takes into account its own needs and resources. (Laakso & Loikkanen, 1997; Chin & Chau, 2003; Kiel & Zabel, 2008.)

From the household's perspective, housing is a combination of different characteristics that influences its price. These characteristics include, e.g., size and type of the dwelling, its quality features, equipment, accessibility, and environment. Households value these

characteristics differently. Using quantile regression, Zietz, Zietz, and Sirmans (2008) find that the valuation of certain features, such as the number of bathrooms and floor area, varies between the house purchasers depending on their price range. Also, households' income significantly affects households' ability and willingness to pay, challenging households to balance between the valued features and their assets. (Laakso & Loikkanen, 2004, p. 147 & 257.) In general, dwellings' characteristics are divided into structural, local, and environmental. Moreover, these attributes include both quantitative and qualitative features. (Mok, Chan & Cho 1995; Chin & Chau, 2003.)

According to Chin and Chau (2003), square footage is the single most significant structural attribute. The variable is often seen to have a significant impact on the selling price of a dwelling (Zietz et al., 2008). Wolverton (1997) states that as the floor area of the dwelling increases, the housing prices per square footage tend to decrease. However, Li, Cheung and Sun (2015) find contrary results when examining housing markets in Hong Kong. The authors suggest that the findings are mainly explained by the under-supply of larger apartments of the city. Hence, the correlation between housing size and price is dependent on the type of the dwelling supply of the area. Moreover, the study of Zietz et al. (2008) shows that the appreciation of the floor area variable is dependent on the purchaser's price range. The findings suggest that the buyers of more expensive dwellings value floor area attribute more than the purchasers of lower-priced houses.

Other structural factors include, e.g., floor plan, number of rooms, building materials, age, and building architecture (Chin & Chau, 2003). Several studies (see e.g. Li & Brown, 1980; Fletcher, Gallimore & Mangan, 2000) show that there is a positive relationship between the number of rooms and the house's selling price. For instance, Garrod and Willis (1992) find in their study that the property's value increases by about 7% with every extra room. Yet, as the preferences vary across households, the measurement of structural attributes often becomes more complex (Chin & Chau, 2003). Moreover, Kohlhase (1991) argues that even though the floor area and the number of rooms are

relatively important supranationally, the valuation of other structural variables may differ between nations and even change over time.

Due to the immobility of dwellings, location, and accessibility are among the most significant factors that affect its price (Kiel & Zabel, 2008). Urban areas vary in quality and geography, and the environment is shaped by urban construction. The proximity of the services, jobs, and downtown has a significant effect on housing prices. (Bowes & Ihlanfeldt, 2001; Lönnqvist, 2015, p. 19.) Since there is a limited amount of land within a specific reach, accessibility is capitalized on the value of the land (Gyourko et al., 2013; Laakso, 2015, p. 4). The location has a significant impact on housing prices as good accessibility lowers consumers' transportation costs and improves the access to the services and public goods (Agostini & Palmucci, 2008). The value of land as a building land is, to a large extent, based on the accessibility of the area. Without traffic routes, the land is of little value. (Laakso & Loikkanen, 2004, p. 363.)

However, accessibility may signify different things to different people. Most commonly, the definition of accessibility is the distance to the centre. Yet, the accessibility may also refer to the access to traffic hubs, business areas, recreational areas, seaside, or other services that the household considers important. (Laakso & Loikkanen, 2004, p. 145.) Because the traffic systems improve accessibility, the homes nearby and within the reach are desired. The choice of living environment can also be influenced by the services, which are often clustered in the proximity of traffic stations. Therefore, the location of the traffic station can bring added value to the consumer and increase the housing demand in the area. Regional factors are well reflected in housing prices. (Adair et al., 2000; Bowes & Ihlanfeldt, 2001; Lönnqvist, 2015, p. 19.)

Concepts of environment and location differ from each other as location measures distance and reach specific sites, whereas environment refers to human interaction, urban development, and built or natural environment. Environmental variables include air quality, noise, accident risks, emissions, area architecture, social structure, income

level, and reputation of the neighbourhood and its residents to name a few. (Laakso, 2015, p. 16.) According to Montero, Fernández-Avilés, and Mínguez (2018), environmental variables have a significant effect on dwelling prices, indicating that the environment is seen as a luxury good. Moreover, Gyourko et al. (2013) analyse the metropolitan areas in the US and find that due to the inelastic supply, some of the unique locations enjoy disproportionate growth in housing prices as the dwelling demand in the area increases. In their study, Tyrväinen and Lönnqvist (2007) discover housing prices in eastern Helsinki being significantly impacted by the distance from the coastline. Similarly, the same statistically significant impact is found in the housing prices of northern Helsinki when analysing the distance to Central Park. The results imply that the environmental factors affect dwelling prices also in the Finnish housing market.

The tenure of a house can be obtained by renting, buying, or, alternatively, getting a right of residence on a leasehold property (Laakso & Loikkanen, 1997). In addition to the form of tenure, the most basic choices in the dwelling selection process include housing type and location. In fact, the owner-occupied house is both a consumption and investment good as it often is the household's most valuable asset. Therefore, an owner-occupied dwelling can be analysed beside as a commodity consumption, also as an investment or saving decision. The investment decision may be influenced by the increase in the expected future value in the dwelling's price. (Ioannides & Rosenthal, 1994; Lönnqvist, 2015, p. 27.) Moreover, Davis and Heathcote (2005) state that housing depreciates significantly slower than other business capital in general and, hence, some of the dwellings are purchased solely from an investment perspective.

3.1.2 Macroeconomic framework

The housing market plays an important role in the national economy. While the effect of the relationship of fluctuations between housing and other wealth assets on the banking crises has been a studied phenomenon, the area of research on the interaction of the

housing market and macroeconomy was not observed until the late 1990s. (Oikarinen, 2011, p. 128.) In addition, several studies (see e.g. Iacoviello & Neri, 2010; Cesa-Bianchi, 2013) claim that the recent financial crisis and the consequential recession forced many to acknowledge the role of a housing market as a driver of macroeconomic fluctuations and business cycles. Moreover, studying the United States market and its spillover effects, Bagliano and Morana (2012) show that financial shocks are transmitted to other countries through stock and housing price dynamics.

The housing market is closely linked to capital markets and macroeconomic developments, as dwelling acquisition often requires external financing. Facilitating access to external finance increases consumers' purchasing power, ultimately leading to growing demand. Eventually, an increased demand forces housing prices to rise. (Goodhart & Hofmann, 2007, p. 15; Lönnqvist, 2015, p. 27–28.) Several studies (see e.g. Liang & Cao, 2007; Goodhart & Hofmann, 2007, p. 147–156; Oikarinen, 2009b) provide empirical evidence to support the linkage between bank lending and housing price development. Analyzing 18 industrialized countries, including Finland from 1980 to 1998, Goodhart and Hofmann (2007, p. 147–156) find a two-way causal relationship between dwelling prices and loan stock. Even though the results show that in Finland's case, the linkage is insignificant, the interaction strengthens over time.

More recently, Oikarinen (2009b) studies Finnish housing market from 1970 to 2006 and finds a causal relationship between dwelling prices and bank lending in Finland since the financial deregulation in the late 1980s. The author claims that before the financial liberalization, the relationship is notably weaker. According to Quercia, McCarthy, and Wachter (2003), affordable lending efforts increase the access to homeownership also for underserved populations. Moreover, the findings show that the impact varies between different groups indicating that more tailored products are needed for targeting specific groups of the population.

Glaeser, Gyourko, and Saiz (2008) and Huang and Tang (2012) provide evidence that lower elasticity of housing supply is linked to booms in housing prices. Contrary to the study of Glaeser et al. (2008), Huang and Tang (2012) find that the linkage also exists during bust cycles when housing prices decline. Similarly, Paciorek (2013) describes two channels through which housing supply constraints increase the volatility of the housing market. First, restrictive regulations, as it increases delays in the housing construction process and, second, geographic constraints that limit the potential housing area. Furthermore, Bahadir and Mykhaylova (2014) distinguish the shocks of housing supply and demand when analyzing their effect on the housing market volatility with a two-way real business cycle model. The results show that shocks of the supply side lower the housing price fluctuations and, therefore, lead to mitigated volatility.

According to Iacoviello and Neri (2010), one-quarter of the cyclical volatility of dwelling prices is explained by the housing demand shocks. Yet, the changes in residential investments and dwelling prices are also influenced by supply shocks in the housing market. The authors study the housing market in the U.S. from 1974 to 2007 and find a significant and negative linkage between dwelling investment and prices on three separate events. The findings suggest that the housing market is primarily driven by the factors of the supply side during these intervals. Bahadir and Mykhaylova (2014) point out that delays, to which the construction industry is subject to, are often behind the shocks of housing supply. As the supply lags from the demand, the housing prices tend to rise. Increasing housing prices, in turn, generate a boom in the construction industry. As a result, an exaggerated building activity leads to permanent shifts in conditions of either housing supply or demand. Therefore, the authors emphasize the importance of capturing the nature of the shocks of the construction industry early on.

The attractiveness of the area is determined by the households by, e.g., area's amenity, its industrial structure, housing supply, and competitiveness of local firms. This may create differences in regional housing price development. In general, increasing housing prices lead to a need and, therefore, claims for higher salaries making the area less

attractive for those households outside the labor market. In the long-run, this might lead to a substitution effect as the housing price differences create a flow of households and jobs between higher and lower-priced areas. Yet, the co-movement is stronger within a metropolitan area than between the remote housing markets. (Oikarinen, 2007.) Also, studying the Finnish housing market, Laakso (2000) finds that local demand factors, especially the employment rate and income level, have a significant effect on housing prices, as rising employment rate and income increase the housing prices of the area.

Mankiw and Weil (1989) claim that the demographics, and especially the fraction of the 20 to 30-year-old population, have a significant effect on housing prices in the long run. Applying a life-cycle model, Ortalo-Magné and Rady (2006) find a significant and positive linkage between the income of younger households and housing price development. Studying the housing market in the HMA, Kuismanen et al. (1999) provide evidence that demographic demand is a significant driver of housing prices in the area. Moreover, Laakso and Loikkanen (1995) show that the housing demand in the HMA is strongly dependent on the age of the household head. The authors argue that the housing consumption of households increases systematically during their life cycle. Besides, the results suggest that the housing demand in the HMA is also affected by other factors such as permanent income, household size, and education level of the household head.

The development of the dwelling market can also influence macroeconomic development through different mechanisms. For instance, the rise in the value of a dwelling increases its owner's wealth through the wealth effect, which can result in the consumption growth of other goods. Several studies (see e.g. Benjamin et al., 2004; Campbell & Cocco, 2007) show that the wealth effect of housing stimulates an even greater increase of consumption than the same effect of other financial assets. Furthermore, Iacoviello and Neri (2010) claim that housing market spillovers are especially centered on consumption, and the effect has become more significant over time. Analyzing the appreciation of houses in the United Kingdom, Campbell and Cocco (2007) find that the largest consumption growth stems from older homeowners. On the

other hand, Juster et al. (2006) argue that the wealth effect hinders the spending response of the houses due to price appreciation. Also, increased housing expenses restrain the consumption possibilities for other commodities (Lönnqvist, 2015, p. 27–28).

3.2 Previous studies

As the housing price formation is discussed, a good theoretical basis is developed for understanding the housing price dynamics. However, theoretical models often contain assumptions that are not usually fully valid in reality. The purpose of this chapter is to review previous empirical studies on the relationship between macroeconomic factors and housing prices and discuss their findings. This chapter presents both domestic as well as foreign studies to increase the reliability of the literature review. Moreover, the examination of the previous studies and their findings might be useful when concluding on the empirical results of this study.

3.2.1 Gross domestic product

GDP is one of the most important indicators of economic cycles. It is widely used in studies to explain the price changes in the housing market (see e.g. Goodhart & Hofmann, 2008; Valadez, 2010; Adam & Füss, 2010). Valadez (2010) examines the dependency of GDP changes and housing prices in the United States from 2005 to 2009 and finds a statistically significant impact of GDP changes on housing price development. Studying the Finnish housing market, Kuosmanen and Vataja (2002) and Oikarinen (2006) provide evidence of GDP being statistically significantly correlated with housing price fluctuations suggesting that there is a direct linkage between Finnish housing prices and the development of GDP. Moreover, the Granger causality tests of both studies show Finnish housing market to anticipate the development of GDP.

Several studies (Goodhart & Hofmann, 2008; Madsen, 2012) find a strong short-term nexus between the GDP and the housing market. The results of the study of Cesa-Bianchi (2013) suggest that the effect of housing demand shocks in the United States leads to an expansion of real GDP, yet, the effect lasts only for a short period. Also, Madsen (2012) claims that the relationship weakens in the long-term. In their study, Tsatsaronis and Zhu (2004) examine 17 industrialized countries and detect that the GDP contribution is less than 10% of the total variation of dwelling prices in the long-term. Also, Adams and Füss (2010) show that a one percent increase in the GDP results in a 0.78% increase in Finnish dwelling prices in the long run based on the dynamic least squares method. Similarly, Oikarinen (2007) finds utilizing a vector correlated model that a long-term GDP growth results in a 0.42 increase in housing prices and, thus, suggesting that there is a strong nexus between the two variables in Finland.

3.2.2 Inflation

The impact of inflation on housing prices is relatively extensively studied, yet, the studies include contradictory results. Several studies (see e.g. Manchester, 1987; Tsatsaronis & Zhu, 2004; Madsen, 2012) find inflation having a negative effect on housing prices through nominal interest rates. Madsen (2012) emphasizes the importance of monetary policy as a tool in controlling the inflation of housing prices in the short run. Manchester (1987) provides evidence using a two-step least squares method of inflation elasticity of real housing prices to be as high as 2.43 in the United States. Furthermore, Brunnermeier and Julliard (2008) argue that a notable proportion of the time series variation of the housing mispricing is explained by inflation and nominal interest rates. To strengthen, the authors emphasize that the findings are unlikely to be validated by the tilt effect.

Contrary to these findings, Kuosmanen and Vataja (2002) provide evidence of a positive correlation between inflation rate and housing prices in the Finnish market, yet, the coefficient is solely 0.08 and, also, statistically insignificant. The authors point out that a

positive relationship between inflation and housing prices is hypothesized since the housing price fluctuations are included in the indices that measure inflation. Moreover, analysing 17 industrialized countries, including Finland, from 1980 to 2007, Frappa and Mésonnier (2010) provide evidence of a significant and positive influence of targeted inflation on the growth of real dwelling prices and, also, on the price-to-rent ratio of housing. Thus, the implemented monetary policy is a major contributor to the development of the housing markets.

The sudden decrease in inflation typically indicates that the economy is either already in the recession or entering the recession. As it takes time for the rental housing agreements to adjust to the decreased inflation rate, the excess rent returns are made by the house owners. This results in a money illusion effect, as the house owners underestimate the risk related to the housing and, also, overestimate the dwelling prices. Therefore, because of the money illusion, Tsai (2020) and Brunnermeier and Julliard (2008) state that decreasing inflation can increase dwelling prices. For instance, when simply comparing monthly rents to housing loan payments when deciding whether to rent or buy a house, the effect of inflation is often failed to be acknowledged as it decreases future real costs of mortgages.

3.2.3   Unemployment rate

Mian and Sufi (2014) provide evidence that during the recent financial crisis, declining housing prices lead to the rise in the unemployment rate because of the decreased consumption. Similarly, Kuismanen et al. (1999) find a statistically significant and negative effect of the unemployment rate on the housing prices in the HMA. Similarly, studying the Finnish housing market, Laakso (2000) provides evidence that rising employment rate increases the housing prices of the area. To strengthen, Liu, Miao, and Zha (2016) analyse housing markets in the United States, and show using a dynamic

general equilibrium model that land prices and unemployment rates are negatively correlated, meaning that as the unemployment increases, the land prices fall.

Moreover, the expectations of future income development affect the demand for owner-occupied housing at the micro-level. According to several studies (see e.g. Diaz-Serrano, 2005; Robst, Deitz & McGoldrick, 1999; Haurin, 1991), the uncertainty of future earnings reduces the demand of housing. Haurin (1991) shows that 10 percent of intertemporal variability of income decreases homeownership correspondingly to a 5% reduction of income. Also, Robst et al. (1999) present similar results of income uncertainty lowering the probability of homeownership. Diaz-Serrano (2005) argues that the households' risk-aversion explains these results. Also, Oikarinen (2005) finds a statistically significant impact of income levels and future income expectations on housing prices in the HMA. However, Kosonen (1997) shows the income uncertainty is insignificant from the unemployment rate in the Finnish housing market.

Also, the linkage between homeownership and unemployment has been widely studied. Several studies (see e.g. Isebaert, Heylen & Smolders, 2015; Coulson & Fisher, 2009; Oswald, 1996) find using either regional or cross-country data that a higher regional homeownership rate results in a higher unemployment rate. To justify, Oswald (1996) suggests that ownership of housing increases the unemployment rate due to the geographical immobility of the homeowners in comparison with renters. To confirm the Oswald hypothesis, Isebaert et al. (2015) provide evidence of a one percent increase in homeownership leads to a 0.35 percentage points decline in the employment rate. Studying the distinct Finnish housing markets of the early 1990s, Laamanen (2017) detects similar results. The author suggests that the findings may be explained by the increased competition in the local job market and the consumption reductions. Yet, according to Coulson and Fisher (2009) and Laamanen (2017), homeownership is still associated with a lower probability of unemployment compared to renters.

3.2.4   Building cost index

Housing prices should, in theory, be explained by the input prices of construction, consisting of the price of land and construction costs. However, housing prices have increased faster than construction costs. From 2004 to 2007, construction costs rose faster than the general price level, but even then, the housing prices increased more rapidly. Interestingly, land prices have risen notably faster than housing prices since 1997. Because the increase in construction has been moderate and the margins of construction companies have not risen excessively, the increase of housing prices has capitalized on the land values. Furthermore, housing prices explain land prices better than vice versa, yet, the causality is not unambiguous. It is worth noting that the buildable land area is a limited resource, which also reflects on its pricing. (Oikarinen, 2014; Kivistö, 2012.)

Gounopoulos et al. (2012) examine the housing market in Greece for a 26-year period and find that the labour and construction costs have a positive impact on the dwelling prices whereas, non-construction investments and interest rates have a negative one. Construction investments were a major contributor to the GDP growth in Finland that started in 2015. Moreover, the construction sector is a significant employer and, therefore, a driver also for employment rate. (KTI, 2019.) Interestingly, Davis and Heathcote (2005) find a positive correlation between working hours and output in all industries, yet, the relationship is found to be most volatile within the construction business. Laakso (2000) states that in Finland construction costs follow closely housing price development as dwelling price fluctuations have a significant effect on the construction industry. For instance, falling housing prices reduce the profitability in the construction business, leading to a decreasing employment and total output. The same holds other way around, as the increasing housing prices stimulate housing production. (Bjørnland & Jacobsen, 2010.)

3.2.5 Interest rate

According to Laakso (2000), real post-tax interest rates reflect to the combined effect of interest rates, inflation, and tax deduction, which have a strong negative impact on housing prices. In other words, as interest rates rise, housing prices fall correspondingly. Similarly, using the VAR analysis, Kuosmanen and Vataja (2002) find increasing interest rates inflicting on Finnish housing prices in the long run. According to Oikarinen (2005), the Finnish housing markets are especially vulnerable to interest rate fluctuations since the majority of the housing loans are tied to interest rates that change on a relatively frequent basis. As the interest rates rise, the mortgage payments increase, challenging many households to meet the increased payment requirements and, therefore, contributing to the selling pressure in the market. If the macroeconomic conditions in Finland are not stabile as interest rates rise, the economy might face severe damages. Thus, it might be reasonable that more of the Finnish housing loans were tied to the interest rates that are fixed.

Interestingly, Kuosmanen and Vataja (2002) find a statistically significant positive linkage between the changes in inflation and interest rates. The findings implicate that, in general, the rising interest rates are unfavourable for the housing investors, especially in the developed financial markets. Therefore, the realization of low inflation rates in the European Union should be in the interest of a Finnish investor. On the other hand, also the housing prices seem to have an impact on interest rates. Examining three small open economies, Bjørnland and Jacobsen (2010) provide evidence that as the housing prices decline by 3–5%, the monetary shock follows, which, in turn, elevates interest rates by one percentage point. Moreover, the authors find that the interest rate responds systematically to the shifts in housing prices. Yet, the timing and strength of the response vary between countries.

3.2.6 Credit constraints

A mortgage is applied by the household and granted by the bank. The amount of the housing loan is based on the household's after-tax income, its expenditures, and other information. Generally, the maximum mortgage repayment is 25–30% of the household's income, but it also depends on the country and the economic circumstances. However, banks often tend to underestimate the risk factors that affect households' abilities to repay the mortgage. These risk variables include factors such as a decline in house prices, getting divorced, or being unemployed. The probability of the inability to repay the housing loan increases as more risk variables are included. (Hulchanski, 1995; Madsen, 2012.)

Several studies (see e.g. Stein 1995; Yamashita, 2007) emphasize the importance of credit constraints in the empirical modelling of housing prices. Using a general equilibrium model, Jin and Zeng (2004) show that due to the liquidity constraints, the monetary shocks have a strong effect on housing prices. One of the key findings of the study of Barakova et al. (2003) is that especially constraints based on credit quality and wealth significantly hinder the access to homeownership. Also, Ortalo-Magné and Rady (2006) provide empirical evidence of financing constraints, especially faced by younger households, having a strong effect on the housing price dynamics. Moreover, the authors find that housing prices and the income of young households are strongly and positively correlated. Besides, Laakso (2000) states that in Finland, apartments, buildings, and land sites play a significant role as securities for housing, consumer, and also corporate loans. Financial markets and, particularly, interest rates and access to finance are of vital importance to the housing markets and their fluctuations.

Oikarinen (2009a) claims that changes in household debt can be utilized in predicting the increase in future housing prices. According to the theory, the availability of credit impacts housing prices. More precisely, the better the availability of credit, the bigger the demand for housing, assuming that the households are borrowing constrained. The

increased demand, on the other hand, elevates the housing prices. (Oikarinen, 2009b.) Moreover, Goodhart and Hofmann (2007) show that housing prices have a significant impact on bank lending. Similarly, Oikarinen (2007) claims that bank lending decreases as housing prices drop and vice versa due to the collateral role of housing. The higher the housing prices are, the more money bank lends, contributing to the consumption, yet, creating a major risk factor for the sustainable functioning of the financial sector as learned from the global financial crisis of 2008.

3.2.7   Stock markets

The interaction of stock markets and housing markets has been a subject of interest in many studies. Although these markets are different in nature, their development curves often tend to follow each other. Simultaneously, both of the markets are influenced by the same macroeconomic factors and, interestingly, often to parallel directions. (Oikarinen, 2006.) According to Kuosmanen and Vataja (2002), the Finnish housing market is more vulnerable to shocks compared to the stock market. Moreover, several studies (see e.g. Chen, 2001; Quan & Titman, 1997; Takala & Pere, 1991) provide empirical support for the interdependence of the stock and housing markets so that the development of stock markets anticipate the development of housing prices. Quan and Titman (1997) study the co-movements in 17 countries and find the correlation to be the strongest in the Asia-Pacific region, whereas in the United States, there is no evidence of a correlation. Hence, the findings indicate that the relationship varies between countries. The authors suggest that economic structures of the countries explain the dispersion of the results.

Kuosmanen and Vataja (2002) provide evidence of the positive correlation between the stock markets and the housing prices in the HMA. The impulse response analysis shows that a sudden rise in stock prices results in a statistically significant increase in housing prices and that the reaction lasts for about three months after the shock. The authors

suggest that positive development of the stock market may also reflect to the Finnish housing markets as investors diversify their assets, yet, due to a high correlation between the markets, the investment is not rational from the diversification point of view. Moreover, the VAR analysis shows that in a longer perspective, both stock and housing markets react negatively to rising inflation and interest rates. Besides, the stock prices are directly dependent on the dwelling prices, which is particularly evident in the stock prices of the banking and insurance sectors.

Studying the housing price dynamics with cointegrated vector autoregressive model, Oikarinen (2006) finds a statistically significant correlation between the stock market and Finnish housing market. The author finds stock market to significantly explain the changes in the housing prices. Yet, the co-movement between stock markets and housing prices has weakened since the liberalization of the financial markets in Finland. Therefore, the diversification benefits of the two asset classes have increased over time. Moreover, contrary to the findings of Takala and Pere (1991), Granger's causality tests show that housing prices anticipate the stock market development and not the other way around.

4 Data and methodology

The purpose of this chapter is to delve into the data and methods used in this study. The selected period of examination is from the first quarter of 1990 to the last quarter of 2019. Because the data is on differences, the data of the first quarter of 1990 is utilized as a base data for the differentiation. The selection process of the macroeconomic variables used for this study are based on the previous literature. First, the data on the macroeconomic factors of the study is introduced followed by the description of their development during the period of examination. After that, the methods used in this study are presented. The econometric analysis is based on the time series analysis and the regression method used is OLS which will be elaborated further during this chapter.

4.1 Data

Generally, the empirical research on dwelling price dynamics faces problems with the data, which is, to a large extent, due to the heterogeneous nature of houses. Also, because the average quality of houses may change over time, the time series data of average sales prices may be biased. Ideally, the dwelling price series would be quality-adjusted, but, unfortunately, these series are generally relatively short and scarce in nature (Oikarinen, 2007). Also, monitoring the changes in average housing prices or other micro-level housing data would not be appropriate relative to time series analysis as the structure of houses sold may vary significantly over time. Therefore, the utilization of quality-adjusted indices, i.e., the hedonic price indices, is considered desirable.

In this thesis, the selected data to investigate the housing price development in the HMA is the housing price index of old dwellings, which is published by the Official Statistics of Finland. According to the Official Statistics of Finland (2020b), old dwellings refer to those dwellings completed two years or more before the year of examination. The indices describe the development of the average dwelling price per square metre of

completed transactions. The time period for the dataset is from the beginning of 1990 to the end of 2019, and the data is in quarterly figures. Thus, the total number of observation points is 120. The motivation for using quarterly data in the study is based on the fact that the monthly data of the indices is solely available from 2005 and, thus, the examination period would have shortened by 15 years. Also, the use of yearly data would be inappropriate for this study, as it would suffer from a shortage of observation points.

McGough, Tsolacos, and Olkkonen (2000) provide evidence of the regional GDP of Helsinki being strongly linked to the national GDP of Finland. Because the HMA is the main economic area of Finland and comprises over 20 percent of the Finnish population and an even greater proportion of the national level GDP, the finding is expected. Therefore, the utilization of national level data of the GDP in this study is justified. The quarterly data is provided by Thomson Reuters Eikon and, the examined time period is from the beginning of 1990 to the end of 2019. Moreover, the data is working days and seasonally adjusted.

Also, the unemployment rate varies on a seasonal basis. In the summer, the unemployment rate is lower than, for example, at the beginning of the year. Generally, people graduate in spring and start searching for a job and, hence, enter the labour market when the unemployment rate is at its highest. Correspondingly, in the summer, some have been employed, which lowers the ratio. In other words, the seasonality is caused by fluctuations in labour supply and demand. As the time series that include seasonality does not give a real picture of the development, the data obtained from the Official Statistics of Finland is seasonally adjusted. The unemployment rate is the ratio of the unemployed to the labour force, both of the groups including the population from 15-year to 74-year olds. Figure 5 below illustrates the development of Finnish GDP, the growth rate of GDP, and the unemployment rate from 1990 to 2019, where the values of GDP are presented in 2010 prices.
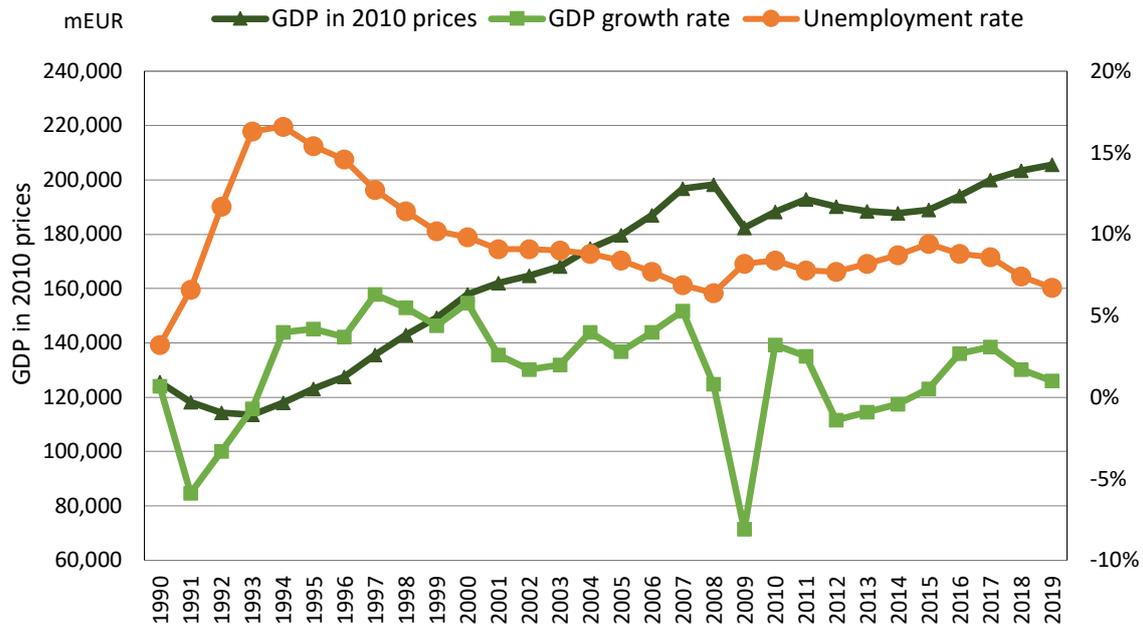
Figure 5. GDP in 2010 prices, GDP growth, and the unemployment rate in Finland (Official Statistics of Finland; Thomson Reuters).

As can be seen from Figure 5 above, the deep recession of the early 1990s caused rapid growth in the unemployment rate and a decrease in the national GDP. During the years of recession, the unemployment rate reached its peak at nearly 17% in 1994. The recovery of the economy first reflected in the GDP growth rate, and only a few years later, also the unemployment rate started to decrease. At its best, the GDP reached an annual growth rate of over 5 percent in the late 1990s. According to Figure 5, the unemployment rate decreased steadily to even below six percent until the 2008s, when the effects of the financial crisis started. However, the unemployment rate did not reach the same levels as in the early 1990s. As noted in Figure 5 above, the financial crisis also inflicted the GDP. The effect is notable when analyzing the GDP growth rate, which decreased over eight percent from 2008 to 2009. Since the financial crisis of 2008, the GDP has continued to increase moderately while the unemployment rate remained at 8% on average.

Oikarinen (2009a) states that due to the absence of data on credit constraints in the Finnish market, adding a household debt variable is reasonable when examining housing price dynamics. The majority of household wealth in Finland consists of homeownership. Similarly, the majority of household loans mortgages. (Laakso, 2000.) According to HYPO (2019a), 96 percent of the Finnish mortgages are tied to Euribor rates, which, in turn, follow the European Central Bank's (ECB) interest rate policy. Thus, the utilization of the 12-month Euribor rate and households' total credit is justified. Before the implementation of the Euribor rates in 1998, the majority of the Finnish loans were tied to the Helibor rate, which is relatively similar to Euribor. Therefore, the 12-months Helibor rate is utilized for the time period from 1990 to 1998 as a substitute for the missing years of the Euribor rate. Figure 6 below describes the development of the Euribor 12-month rate and total credit of Finnish households, which is presented in billions of USD.
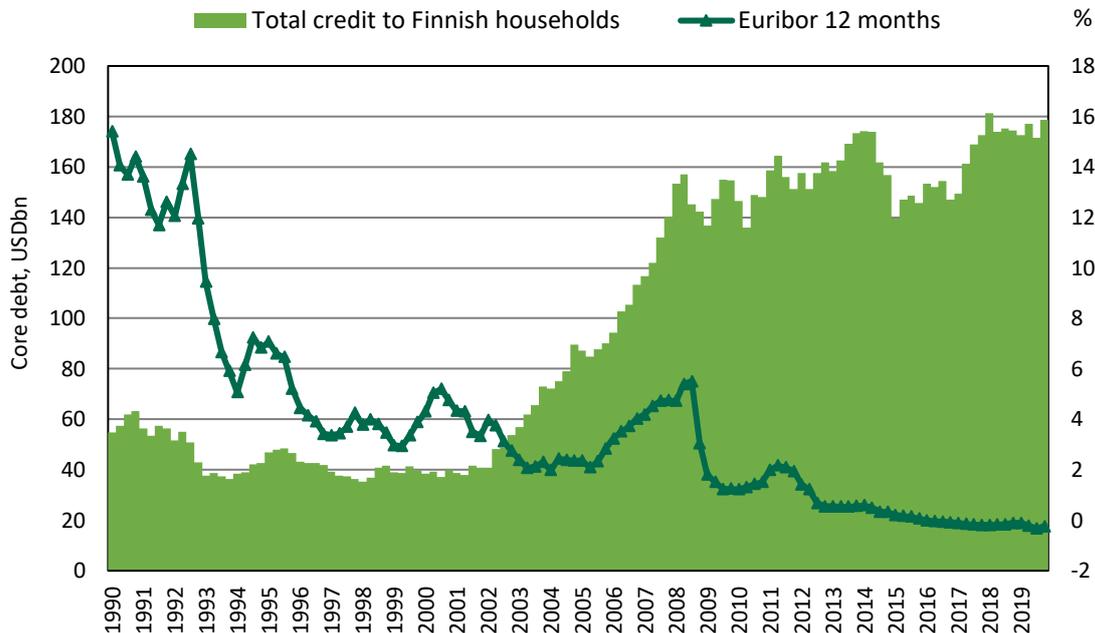

Figure 6. Housing loan stock in Finland and the 12-months Euribor rate (Thomson Reuters).

According to Figure 6 above, Euribor has been decreasing during the observed time period. In 1990, the Euribor rate was 15.4% and decreased rapidly during the following

years. The drop in 1992 resulted from the decision to float the Finnish mark due to which the value of the currency decreased significantly, causing a fall in interest rate (Kuusterä & Tarkka, 2012, p. 668–669). The development of total households' credit was stagnated throughout the 1990s. Since the early 2000s, the borrowing started to increase rapidly and, interestingly, even the financial crisis of 2008 did not affect the borrowing willingness of Finns. Due to the crisis, the ECB employed a softer monetary policy in pursuit of recovering the economy, which can also be noted from Figure 6 above as a decline in interest rate. In 2016, the Euribor fell the first time below zero, and, since then, the Euribor rate has been negative. Currently, as the deposit rate of ECB is -0.5%, the rise is not expected anytime soon. The prolonged decline in interest rate can be expected to contribute to the housing demand and, thus, the increase of housing prices as the borrowing costs are historically low.

The building cost index is obtained from the Official Statistics of Finland, where the year 1990 is the base year for the index and, thus, the index point for the year is 100. The data set describes the relative change in the variable. The monthly data is published since 1990, and it is converted into quarterly figures using Excel. Thus, the final dataset contains the quarterly data from Q1 1990 to Q4 2019, and the total number of observation points is 120. The building cost index portrays relative changes in the costs of construction works, i.e., renovating, as well as building construction, both performed by building contractors. As for the data gathering, the development of costs of basic inputs used in the construction or renovation of buildings is collected by direct inquiries to retailers and producers of construction materials. Also, the index takes into account the wages of construction workers and building service prices of providers as construction as a business is relatively labour intensive. (Official Statistics of Finland, 2020e; Davis & Heathcote, 2005.)

According to Pohjola (2014, p. 183–184), the consumer price index (CPI) is the most commonly used measure of inflation and, hence, CPI is also used in this study as an inflation variable. The CPI measures the change in the purchasing power of money, and

it describes the price development of goods and services purchased by households living in Finland. The index is calculated by a method in which the prices of different goods are weighted together by their consumption shares. The CPI data set obtained from the Official Statistics of Finland follows the formula of Laspeyres' price index, where the weights are related to the base period, which is the year 1983 in this study. As the data is published monthly, it was converted into quarterly figures using Excel, so that the final values are from the first quarter of 1990 to the last quarter of 2019 and, thus, the total number of observation points is 120. Figure 7 below describes the development of the inflation rate in Finland from 1990 to 2019.
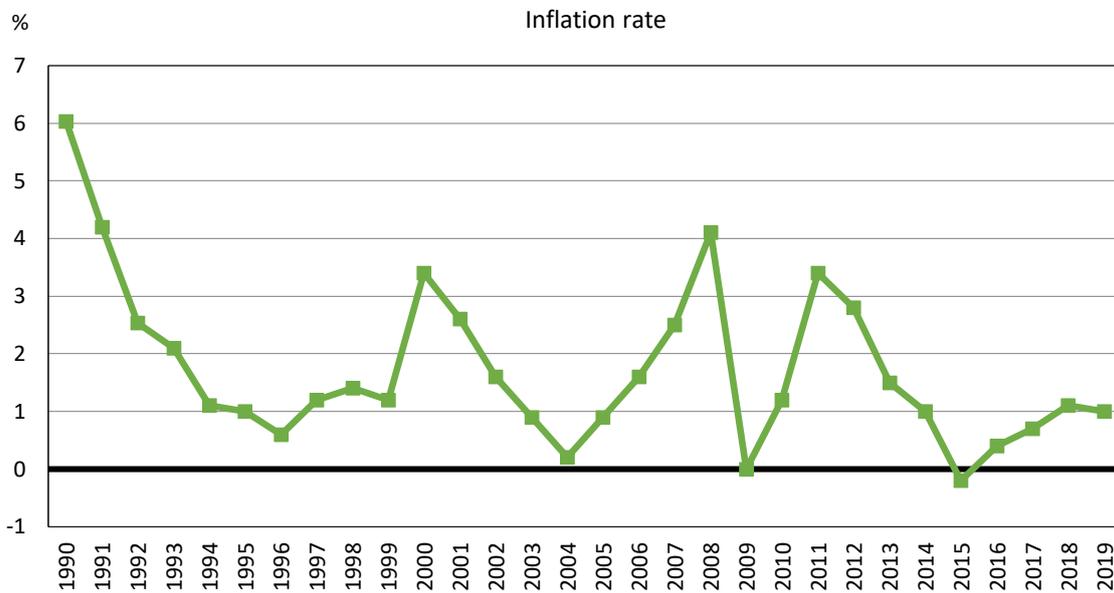

Figure 7. Inflation rate in Finland from 1990 to 2019 (Official Statistics of Finland).

The inflation rate was at its highest before the recession in the 1990s. According to Figure 7 above, the inflation rate has been rising at a brisk pace before economically difficult times, such as the abovementioned great recession in the early 1990s, the information technology bubble in 2000, and the financial crisis in 2008. In other words, when economic activity is brisk, inflation starts to rise. However, the inflation rate has also declined rapidly as a result of these economic downturns. Interestingly, the development

of the inflation rate has been stalled in recent years, as noted from Figure 7, which is partly a sign of the long-running difficulties in the Finnish economy.

In this study, the development of the Finnish stock market is presented by the general price index of OMX Helsinki. The values for the price index of OMX Helsinki are obtained from Thomson Reuters Eikon, where the shares are weighted corresponding to their market value, meaning that the index takes into account the combined development of all trades. Thus, individual stocks can contribute to the formation of the index more than the others, but, on the other hand, also the investors put more weight on certain stocks in their investment portfolios. Therefore, the utilized index can be considered as a good indicator of the general stock market development. Figure 8 below shows the OMX Helsinki price index development from 1990 to 2019.
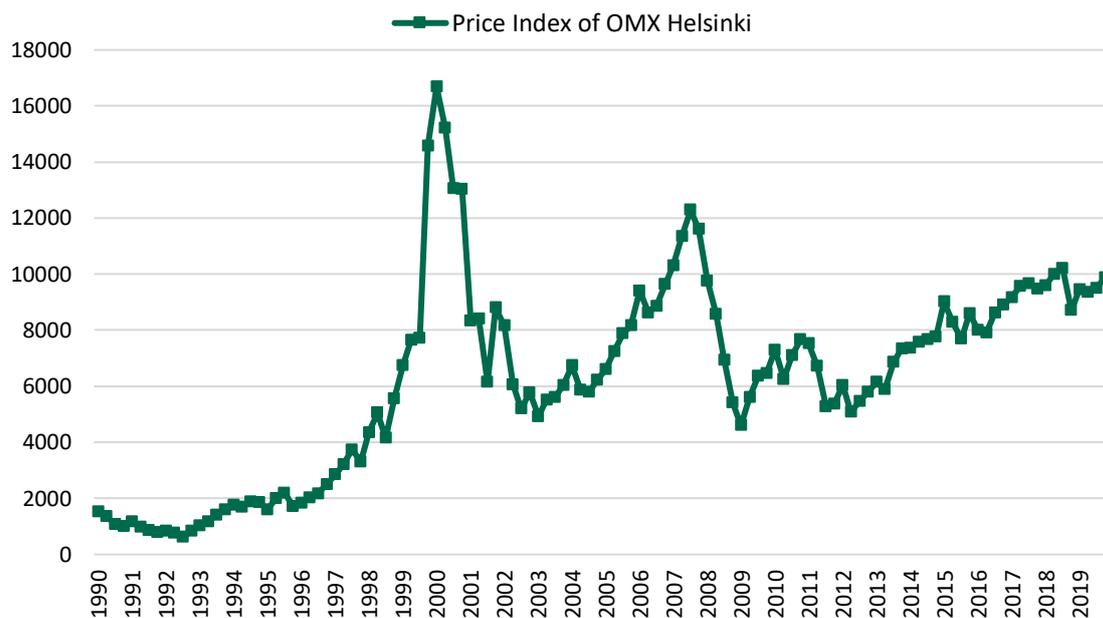
Figure 8. The development of OMX Helsinki price index (Thomson Reuters).

Figure 8 above illustrates well the relatively volatile nature of the stock markets. The growth of the stock markets was relatively moderate in the 1990s. However, the observed time period includes some of the most significant milestones of the stock

market history, such as the information technology bubble in 2000 and the global recession in 2008, which originated from the subprime crisis. Naturally, these events are notable in Figure 8 above as they have had a major impact on the stock markets. In recent years, the growth of the OMX Helsinki has been relatively steady.

4.2 Methodology

This chapter describes the methods used in this study. Utilized methods are based on the econometric analysis. First, stationarity is introduced as is the most important assumption in time series analysis. The subchapter also includes a description of its measurement. The second part of the methodology describes the OLS as it is the method used in the analysis of the housing price dependence on the macroeconomic factors. The OLS is a mathematical optimization method that purpose is to find the best fit for the data. Also, the assumptions related to the OLS method are presented as they are vital when examining the reliability of the model.

4.2.1 Time series analysis

The purpose of time series analysis is to examine changes in the value of a specific phenomenon during the chosen period of time. The most vital and common assumption in time series analysis is stationarity, meaning that probability laws concerning the process do not change in time. In short-term, however, the time series may fluctuate significantly, whereas, in the long-term reference period, the time series may develop cyclically into a certain direction or reveal a trend. In time series analysis, trends or time dependence are referred to as non-stationary, meaning that the expected values of the time series are not constant.

When parameters change over time and, thus, are non-stationary, they can be divided into two subcategories, which are deterministic and stochastic trends. In deterministic time series, a shock can change the price development in the short run, but after that, the time series return on its previous deterministic trend line. The stochastic trend, on the other hand, changes permanently as a result of the shock in the long run. Additionally, stationarity can be divided into weak and strong stationarity depending on the covariance stationarity of the time series. A time series is weakly stationary if its expected value, variance, and all autocovariance remain constant regardless of the time. Autocovariance is depended only on the time difference t–s, not on the time t. In literature, a stochastic process is covariance stationary, i.e., weakly stationary, if for all t and t–s

$$E(y_t) = E(y_{t-s}) = \mu \tag{1}$$

$$E[(y_t - \mu)^2] = E[(y_{t-s} - \mu)^2] = \sigma_y^2 \tag{2}$$

$$E[(y_t - \mu)(y_{t-s} - \mu)] = E[(y_{t-j} - \mu)(y_{t-j-s} - \mu)] = \gamma_s \tag{3}$$

, where the expected value (μ), variance (σ_y^2) and all autocovariances (γ_s) are constants. In addition, the infinity of the expected value and variance is presumed. However, in the case of strong stationarity, neither the expected value nor the variance has to be infinite. In time series modeling, weak stationarity is the most commonly used form of stationarity because it also meets the conditions of strong stationarity in the case of a normal distribution. (Enders, 2014, p. 52–53; Gujarati, 2002, p. 797–798.)

If the time series does not meet the conditions of stationarity, it is characterized as non-stationary. The time dependence is typical for non-stationary time series. Using a non-stationary variable in a regression analysis often leads to erroneous results. One disadvantage caused by non-stationarity is spurious regression, where the results indicate to a significant correlation between variables even though there is no causality.

(Gujarati, 2002, p. 806–807.) It is possible to make non-stationary variables stationary by differentiating them once or more. In the differentiation, the observation y_{t-1} of the previous time is subtracted from the variable y_t. The degree of integration of non-stationary time series is often one and, it is denoted as I(1). In general, if time series are differentiated d times, it's degree of integration is d and, therefore, expressed as I(d). Because the degree of integration of a stationary time series is zero, it is denoted as I(0). (Gujarati, 2002, p. 820 & 839–840.)

Stationarity is tested using a unit root test, which is a formal statistical test. Most commonly, the existence of a unit root is tested with the Dickey-Fuller test (DF) or the Augmented Dickey-Fuller test (ADF). The standard DF test assumes that the tested variable y_t is derived from a simple first-degree autoregressive process, in other words, meaning that only the first lag y_{t-1} is significant in series modeling. However, in reality, there may be a more complex higher-degree autoregressive process where multiple lags should be taken into account in series modeling. In this case, the error terms of the DF test are autocorrelated, and the critical values of the DF distribution are no longer valid. To avoid this, the ADF test was developed based on the DF test. Basically, in the ADF, the issue is eliminated by adding lagged changes to the model. (Gujarati, 2002, p. 817–818.) The pth order autoregressive process of the ADF test is formulated as follows.

$$y_t = a_0 + a_1 y_{t-1} + a_2 y_{t-2} + a_3 y_{t-3} + \cdots + a_{p-2} y_{t-p-2} + a_{p-1} y_{t-p-1} + a_p y_{t-p} + \varepsilon_t \qquad (4)$$

Equation (4) can also be denoted as

$$\Delta y_t = a_0 + \gamma y_{t-1} + \sum_{i=2}^{p} \beta_i \Delta y_{t-i+1} + \varepsilon_t \qquad (5)$$

where $\gamma = -\left(1 - \sum_{i=1}^{p} \alpha_i\right)$ and $\beta_i = -\sum_{j=i}^{p} \alpha_j$.

The coefficient of interest in equation (5) is γ. If the null hypothesis $\gamma = 0$ is valid, the time series y_t contains the unit root. The null hypothesis is tested similarly to the DF test. In other words, the resulted t-value from the ADF test is compared to the critical t-values of the DF test distribution. Correspondingly to the DF test, the deterministic components can be included in the model, such as constant or linear time trend, and compare the resulted t-value with critical t-values. (Enders, 2014, p. 215.)

However, the ADF test also has its challenges, which are mainly due to the lack of knowledge on the real data-generating process. For instance, structural changes may cause trend-like development in the data, in which case the null hypothesis would be erroneously accepted. Also, choosing the appropriate lag length is important because the test result can be sensitive to the number of lags. If too few lags are selected, the autocorrelation of error terms cannot be eliminated. On the other hand, if too many lags are chosen, the test reliability suffers as the null hypothesis is rejected too seldom. (Enders, 2014, p. 216–217.) To select the appropriate lag length, Hall (1994) suggests general-to-specific methodology where the basic idea is to begin with a long lag length and systematically reduce the number of lags by analysing the t-values until the last lag finally becomes statistically significant. Additionally, most of the statistical programs provide the Akaike Information Criterion (AIC) or the Schwartz Information Criterion (SIC) for the appropriate lag length selection.

4.2.2 The ordinary least squares method

The regression method is used to explain the variation in the observed values of a dependent variable by the variation in the observed values of independent factors. The regression coefficients of the explanatory variables show how much the dependent variable reacts to the one-unit change in the explanatory variable while the values of the other independent variables remain constant. A central empirical research model used in housing price studies is the OLS (Lönnqvist, 2015, p. 72). Also, difference-in-difference

estimation is generally used, as it is particularly suitable for studying causality. In this study, the OLS regression is utilized because it is the most appropriate considering the purpose of the study. The OLS is a mathematical optimization method that aims at finding the best fit for the data by selecting the estimates so that the sum of the squares of the residuals is minimized. The formula used in the OLS regression is denoted as

$$\sum_{j=1}^{n} \varepsilon_j^2 = \sum_{j=2}^{n} (y_j - \beta_0 - \beta_1 x_{j1} - \beta_2 x_{j2} - \dots - \beta_k x_{jk})^2 \qquad (6)$$

, where the estimators of the regression coefficients are determined by minimizing the sum of squares of the residual ε_j with respect to the regression coefficients $\beta_0, \beta_1, \dots, \beta_k$. (Brooks, 2008, p. 31–33.)

Each of the OLS estimators of the model should be the best linear unbiased estimator (BLUE). The estimator is considered unbiased when the expected value of the estimator is the parameter itself. Additionally, out of all the possible linear estimators, the variance of the OLS estimator is the smallest. When certain conditions are met, also known as the Gauss-Markov assumptions, the OLS model produces BLUE estimators. The assumptions are as follows. First, all of the studied parameters must be linear and, therefore, meet the assumption of linearity. In addition, all independent variables must be uncorrelated with the error term, and, thus, be exogenous. The errors must be normally distributed and, hence, have zero mean. Also, the data must be randomly sampled from the population. Furthermore, the errors need to be linearly independent of one another. The regressor has to be orthogonal, meaning that it is unrelated to the error term and, therefore, meet the assumption of non-collinearity. Last, the variance of the errors must be constant and, hence, meet the assumption of homoscedasticity. (Brooks, 2008, p. 44–48.)

If the assumptions do not hold, the coefficients of the model are biased and/or their mean errors are false or unreliable. Many of these assumptions are rarely met with the

actual data. In particular, heteroskedasticity and abnormally distributed error terms cause issues. In the case where the conditions are not met, the model can be improved by, for instance, changing the values to their logarithmic format. Linear transformations do not affect the goodness of the adapter or predictions, yet, they have an effect on the interpretability of the model. (Brooks, 2008, p. 38–39.)

The most important objective of the regression analysis is to explain the behaviour of the dependent variable. In general, R^2 is often the subject of interest in the regression analysis, as it is a statistical measure that shows how well the actual data is approximated by the regression line. It is considered as an explanatory factor and, hence, often used as a measure of the goodness of fit for the model. Mathematically formulated, R^2 is a ratio of the regression sum of squares and the total sum of squares. The highest possible value for R^2 is one. If there is no relationship between the dependent and independent variables, the R^2 is close to zero. (Brooks, 2008, p. 106–109.) Therefore, it is desirable to achieve as high value of R^2 as possible.

5   Empirical results

Before the econometric analysis, unit root tests are performed on the logarithmic values of the building cost index, CPI, price index of old dwellings, GDP, household debt, and OMX Helsinki variables, as the stationarity of the time series must be verified. The interest rate and unemployment rate are excluded from the unit root testing as they can already be presumed as stationary due to their nature. The stationarity of the time series is tested using the ADF in EViews and, also, the for the lag length selection SIC is used. The results of the ADF are summarized in Table 3 below. The test is conducted based on the logarithmic values of the variables. As the null hypothesis of the ADF suggests that the time series have a unit root, thus, meaning that they are non-stationary. Moreover, the null hypothesis cannot be rejected if the absolute value of the t-value is less than the critical t-value.

Table 3. The results of the ADF unit root test.

Significance level	Critical t-values	Variable	t-value	p-value	Stationarity
1%	(−3.487)	Building Cost Index	(−0.157)	0.940	Non-stationary
5%	(−2.886)	CPI	(−0.979)	0.759	Non-stationary
10%	(−2.580)	Price Index of Old Dwellings	(−0.548)	0.876	Non-stationary
		GDP	(−0.392)	0.906	Non-stationary
		Household Debt	0.074	0.963	Non-stationary
		OMX Hki	(−1.374)	0.593	Non-stationary

According to Table 3 above, the absolute values of the achieved t-values on all variables are below the critical t-values on all significance levels, meaning that all the examined variables contained a unit root. Therefore, the findings of the ADF unit root test suggest that the null hypothesis cannot be rejected and, thus, all the variables analysed are non-stationary, as concluded in Table 3 above. Due to the non-stationarity, the logarithmic

differences are taken from all the examined variables and, therefore, the integration level of the values is one. These values can be interpreted as approximate percentage changes. Next, the ADF unit root test is conducted based on these values. The results are presented in the following Table 4 below. Because the absolute values of the resulted t-values are all higher than the corresponding critical ones, the null hypothesis can be rejected at a 1% significance level. To conclude, the logarithmic differences of all the examined variables are stationary, as presented in Table 4.

Table 4. The results of the ADF unit root test of logarithmic differences.

Significance level	Critical t-values	Variable	t-value	p-value	Stationarity
1%	(−3.487)	Building Cost Index	(−4.349)	0.000	Stationary
5%	(−2.886)	Consumer Price Index	(−4.658)	0.000	Stationary
10%	(−2.580)	Dwelling Price Index	(−4.414)	0.000	Stationary
		GDP	(−8.038)	0.000	Stationary
		Household Debt	(−8.850)	0.000	Stationary
		OMX Hki	(−10.076)	0.000	Stationary

Next, as the stationarity of all the above-mentioned variables is confirmed, the employed data is usable in the econometric analysis. Moreover, as the unemployment rate was exceptional at the beginning of the 1990s due to the recession, the data of the unemployment rate is converted into differences to avoid the deep recession from distorting the results of the OLS regression. Also, the data of the interest rate variable is used as of its current state. The dependent variable of the regression is the price index of old dwellings, and the results of the OLS regression are presented in Table 5 below.

Table 5. The results of the OLS time series regression.

Explanatory variable	Coefficient	Standard error	t-Statistic	Probability
Building Cost Index	1.765	0.445	3.971	0.000**
CPI	(-0.527)	0.560	(-0.942)	0.348
GDP	0.407	0.188	2.171	0.032**
Household Debt	0.054	0.039	1.349	0.180
Interest rate	(-0.068)	0.027	(-2.498)	0.014**
OMX Hki	0.044	0.015	2.849	0.005**
Unemployment rate	(-0.260)	0.218	(-1.191)	0.236
R^2	0.375			

According to the results presented in Table 5 above, the price index of old dwellings in the HMA exhibits significant and positive co-movements with building cost index, GDP, and OMX Helsinki variables. Based on the previous studies, it can be assumed that the impact of economic growth on housing prices is resulting from the increased demand, which, in turn, leads to higher dwelling prices. Furthermore, the increase of wealth and the fair values of collateral reduces the housing loan payments, which may reflect further in the growing demand for housing, resulting in rising housing prices. Therefore, the positive co-movement between the Finnish GDP and housing prices in the HMA is in accordance with the previous literature of Kuosmanen and Vataja (2002) and Oikarinen (2006).

The positive co-movement between building cost index and housing price index is the most significant finding of all since the p-value is the lowest, as noted from Table 5 above. The result seems to be in line with the theoretical view of housing prices, where the dwelling prices should be explained by the input prices of construction that consists of the price of land and construction costs. Moreover, according to the study of Laakso (2000), the rising housing prices increase the profitability of the construction business. Therefore, higher housing prices result in increased construction activity, which

contributes to employment and, hence, to the growth of GDP. It can be concluded that the macroeconomic factors are also interrelated to one another as the GDP, building cost index, and housing prices in the HMA exhibit positive co-movements.

The third factor that exhibits positive and statistically significant co-movement with the housing price development in the HMA is the OMX Helsinki variable, as described in Table 5 above. This is an expected result since the previous studies of Kuosmanen and Vataja (2002) and, Oikarinen (2006) provide evidence that the housing markets and stock markets are, in general, influenced by the same macroeconomic factors. Therefore, the two variables tend to move in the same direction, which is also the case in this study. Moreover, as the finding is statistically significant, it is worth mentioning that the diversification benefits of the markets are low, as also stated by Kuosmanen and Vataja (2002).

The results show that the movements of the interest rate variable are significant and negative in relation to the housing price development of the HMA. In other words, the results indicate that as the interest rate rises, the housing prices decrease, and vice versa. This finding is per the previous literature on the Finnish housing markets (see e.g. Oikarinen, 2005; Kuosmanen & Vataja, 2002). Moreover, as the majority of the Finnish housing loans are tied to the 12-months Euribor rate, it seems reasonable that the finding is statistically significant. However, it is worth taking into account that the interest rate decreases throughout the observed time period, as noted in the data section of the study. Therefore, the result might not be as statistically significant in reality as suggested by the p-value.

Other results of the OLS time series regression, i.e. those regarding the CPI, household debt, and unemployment rate variables, are not statistically significant, as can be detected from Table 5 above. However, the negative sign of the coefficient of the unemployment rate is in accordance with the findings of the previous studies of Laakso (2000) and Kuismanen et al. (1999). As the unemployment rate decreases, the housing

prices are expected to increase because of the growing demand for housing. The same also holds the other way around. Moreover, as the demand for housing increases, the housing prices rise, which results in growth in household debt. Therefore, the positive coefficient of the household debt variable seems to be rational and, also, in accordance with the earlier study of Oikarinen (2009b).

However, the negative sign of the coefficient of the CPI variable is opposed to the findings of the study of Kuosmanen and Vataja (2002), which detects a positive, yet, an insignificant correlation between inflation rate and housing prices in the Finnish market. Contrary results can be partly explained by the length of the observed periods. While the period of examination of the study of Kuosmanen and Vataja (2002) is from 1987 to 2000, the observed period of this study is from 1990 to 2019. Thus, the period of examination is significantly broader in this study. Interestingly, the negative movement of the CPI is also an unexpected result since the housing price changes are included in the CPI measure. The result may indicate that inflation affects the housing prices of the HMA through nominal interest rates. Yet, it must be taken into account that this finding is statistically insignificant.

6 Conclusions

It is important to identify the factors that influence housing price development as the housing prices reflect to the development of the whole macroeconomy. In addition, the housing prices significantly affect the household's well-being, as dwellings comprise the majority of household wealth. The purpose of this study is to examine the movements between the key macroeconomic variables and the housing price development of the HMA, as the HMA is the capital region of Finland. Moreover, the demand for housing in the HMA is increasing, and, according to the previous studies, the housing prices of the capital region anticipate the housing price development of the entire Finnish housing market. In this study, the housing price formation and the factors affecting housing price development are discussed, where the effects of the macroeconomic variables on the housing market are of particular interest.

The housing market differs from other markets due to its special characteristics, including, e.g., its heterogeneity, an extremely large amount of required capital, the level of governmental intervention, asymmetric information, high transaction costs, and maintenance costs. Households are the consumers of houses and, the heterogeneous attributes of housing are valued differently from household to household based on their needs. The future development of the housing market in the HMA is expected to continue increasing due to the exceptionally low interest rates, limited housing supply, and growth in demand for housing, which all contribute to the increase in the housing prices of the area.

The empirical part of the study comprises of the examination of the housing price development in the HMA with quarterly observations for the time period from the first quarter of 1990 to the last quarter of 2019. Therefore, the total number of observations is 120. The utilized macroeconomic variables are building cost index, CPI, GDP, household debt, interest rate, OMX Helsinki, and unemployment rate since these variables are identified in previous literature as the key macroeconomic factors that

affect the development of the housing market. The stationarity of the time series of CPI, GDP, dwelling price index, household debt, and OMX Helsinki, are tested using the ADF test in EViews. After the stationarity is confirmed, the data sets are usable for the OLS regression.

The results of the utilized OLS time series regression reveal that the price index of old dwellings in the HMA exhibits statistically significant and positive co-movements with building cost index, GDP, and OMX Helsinki variables. These findings are expected, as they are following the previous literature. In general, the economic growth results in increased demand for housing, which elevates the housing prices. Because the stock market is influenced by the same macroeconomic variables as the housing market, the markets tend to move in the same direction. Moreover, as the housing prices are directly influenced by the input costs, the positive co-movement between the building cost index and the housing price development is expected.

The interest rate exhibits a statistically significant and negative movement with housing price development of the HMA. However, it must be taken into account that the interest rate decreases throughout the observed time period. Thus, the finding may not be as statistically significant in reality as the p-value indicates. Also, the negative and insignificant movement of the unemployment rate is per the previous findings. The decreasing unemployment rate leads to the increased demand for housing, which elevates the housing prices. The increasing housing prices also cause the growth of housing loan payments, which explains the positive, yet, insignificant movement of the household debt variable. Interestingly, in oppose to the previous findings, the movement of CPI is negative and statistically insignificant. The direction of the movement of the CPI is unexpected since the housing prices are commonly included in inflation measuring indices.

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