Is there a housing bubble in the Nordic capitals or can house prices be explained?

An assessment of owner-occupied housing markets in Copenhagen, Stockholm and Oslo

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Abstract

Over the past six years, Copenhagen has experienced a substantial surge in housing prices, outpacing the growth in the Danish housing market as a whole. The price escalation has resulted in housing prices reaching their highest ever levels to date and surpassing the 2006 peak prices nominally by 19-22%. Considerable pricing growth has also been experienced in both the Norwegian and Swedish housing markets, as the buoyant Oslo and Stockholm markets also witnessed new price highs. In 2017, however, prices in both Oslo and Stockholm have started to fall, dropping circa 10% from their peak. While the Copenhagen housing market has not yet experienced price declines, the growth has started to slow down substantially. This has led many experts along with the media to question whether Copenhagen will soon experience similar sharp drops in prices.

The purpose of this paper is to establish whether a housing bubble is currently present in the Nordic capital markets for owner-occupied housing, and if not, determining whether the pricing growth can be explained by fundamental factors. Thus, the thesis will provide the reader with an assessment of the current state of the housing markets according to the development in fundamentals.

Firstly, the dissertation will adopt a definition of a housing price bubble with accompanied criteria conducive to housing bubble formation. The paper will discuss important dynamics of the demand and supply in an owner-occupied housing market, both in the long-term and short-term.

Secondly, the historical pricing development of the three Nordic capitals and their respective countries cities housing markets is presented, describing peaks and troughs. The dissertation will then empirically test for periods of under- and overvaluation using traditional housing price models as the Hodrick-Prescott filter and the Price-to-Income ratio. This will assist the paper in identifying signals of bubble tendencies within the examined period of time.

Lastly, a comparative fundamental factor analysis is conducted using fundamental factors suggested by both Case & Shiller (2004) and Jacobsen & Naug (2005), as the underlying mechanism for the recent housing price developments are examined.

Through the empirical research, there was a strong indication that prices in Copenhagen are more overvalued in recent observations. However, the differences in the time period may implicate the result. Furthermore, through the comparative fundamental analysis, it was established that the Stockholm housing market replicates having the strongest bubble tendencies of the three cities.

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1. Introduction

Housing is the largest investment the majority of us make over our lifetime. Conventional wisdom tells that investing in housing is a sensible thing to do, because the value of housing will inevitably increase at some point. In some countries, housing is used as a form of old age saving (Smidova, 2016). Furthermore, housing is used as a means of attaining access to credit, since it is used as collateral as a means of being granted loans, which in turn facilitates individuals' consumption. In Denmark, more than half of the population (approximately 58%) owns housing (DST, 2017a). Thus, the developments within the housing market are of huge importance to many as they can have a significant impact on their personal finances.

The substantial increase in housing prices leading up to the financial crisis in 2007 were later to have damaging consequences for home owners, as well as having serious implications for the financial and macroeconomic stability of Denmark. Danish housing prices had risen steadily during the 1990s but it was in the 2000s where the growth became most substantial. The rise in the housing market began in Copenhagen, most notably in the market for the owner-occupied flats, and soon spread to its surroundings and to Northern Zealand (Dam *et al.*, 2011a). These areas experienced remarkably high price increases. For in Copenhagen alone, the prices of owner-occupied flats doubled in nominal terms over a four-and-a-half-year period from 2002 until mid-2006. In comparison, outside of these areas, prices developed at a much more moderate level.

As a result of the financial crisis, Danish housing prices took a steep nosedive as homeowners experienced large real capital losses in 2008 and in the first half of 2009. According to Spange (2010), the crisis was caused by two interconnected imbalances which had been accumulating for a long period of time. Firstly, there were global imbalances in the form of current account deficits, principally the presence of a large current-account deficit in the US which had rippling effects globally. Secondly, the financial system suffered from severe imbalances in the form of strong credit growth and increased residential investment. Many academics have likewise attempted to identify the triggers of such a crisis. Most are in agreement that the dominant triggers are housing and the credit markets (Østrup, 2009; Muellbauer, 2012; Grytten, 2009).

These two "triggers" are very much interrelated as the access to credit can in turn accelerate housing price growth. As such, they tend to move in the same direction in boom and bust periods. In the "boom period" of 2003-2006 where house prices experienced their most significant growth, lending activities also increased substantially over this period in which interest rates were low at just over a 2 percent level. Other factors likewise accelerated the growth such as low and falling unemployment levels, increased income levels, and the deregulation of the mortgage market. These elements propelled borrowers into more favourable positions as their lending capacities improved. While underlying fundamental factors like these played a part in price increases, it was the speculation that many points to as being one the leading drivers for price levels becoming out of control. For the increase in housing prices and the expectation of future capital gains on housing meant that consumers had an incentive to buy early before prices became more expensive and

unaffordable (Shiller, 2007). The fanatical expectations were unrealistic, however, and with the subsequent downturn, consumers expectations changed as they became pessimistic about future price developments. Rapidly shifting expectations such as these are very characteristic of bubble formations.

Fast-forward to today, and prices in Copenhagen have since reached their highest level to date, surpassing the peak levels of 2006. Unsurprisingly, the skyrocketing of prices since 2011 has re-opened the conversation of whether a "housing bubble" is again present. The presence of a bubble within the capital region would be of great concern. For approximately 45 percent of the nation's household housing wealth is based in Copenhagen, covering approximately 30 percent of the country's housing units, which forms 35 percent of household mortgages' collateral in Denmark (Hviid, 2017).

The fundamental factors this time around are inevitably different from the previous thriving period prior to the financial crisis. Following the crash, interest rates dropped by so much that by 2015 one could attain a fixed 30-year mortgage at a rate of just 1.5% (Bloomberg, 2018a). In 2018, a weaker global financial outlook with accompanied turmoil in stock markets has prompted investors to seek alternative and less risky asset classes which have increased the demand for Danish mortgage bonds. This is to the extent that Danish mortgage institutions reintroduced the 30-year mortgage with a fixed rate of 1,5% to borrowers in July 2018 (Børsen, 2018). Short and long bond rates in Denmark are currently at a historically low level where the former have been traded with negative rates since the beginning of 2015 (see appendix 1). These low interest rates together with the growing and widespread use of non-amortization mortgages is of great concern as Danes would become vulnerable to interest rate hikes and shocks in the future. The fact remains that Danes have the highest percentage of household debt to disposable income in all of the OECD countries, and so measures needed to be taken to curtail this. Regulations were finally introduced in 2015 on mortgage lending as a cap was implemented at a 95% level. However, in comparison to the other Nordic countries, it looks rather lenient. For in Norway and Sweden, the regulations surrounding the cap on mortgage lending is set at a much lower 85% level.

Perhaps worryingly for Copenhagen, housing prices in both Oslo and Stockholm have recently started to tumble. As of January 2018, apartment prices in Oslo and Stockholm have fallen around 10% from their lofty peak levels in mid-2017 (RealKredit Danmark, 2018). The downward turn could possibly be as a result of stricter lending regulations. However, several dynamics effect the development of housing prices which the thesis will attempt to analyse respectively for each capital. Therefore, the purpose of the thesis is to assess the historical development and current state of the three Scandinavian capitals' housing markets, and attempt to identify possible bubble tendencies.

1.1 Problem Statement

For all of the reasons listed above, we have chosen to examine the housing market in the three Scandinavian capitals with respect to owner occupied housing. This will enable the thesis to determine whether or not a housing bubble is present in each of the three respective cities. The problem statement is as follows:

"Are there indications present pointing towards a housing bubble in the Copenhagen, Stockholm and Oslo markets for owner occupied housing?"

In the thesis' attempt to answer the above problem statement, the following sub questions are investigated:

"To what extent does traditional empirical housing price models indicate overvaluation during the examined period for the three Nordic capital markets?"

"Can the real price development in the Nordic capital housing markets be explained by fundamental factors?"

1.2 Dissertation outline

The thesis will attempt to answer the above problem statement and the accompanied sub questions using empirical housing price data and by analytically assessing and discussing key fundamental factors. A description of the applied data and the theoretical motivation behind the choice of the measure of house prices will be presented. Additionally, various delimitations are outlined.

The first part of the thesis will provide the reader with a definition of a housing bubble and the criteria of such, which will be examined throughout the paper. Furthermore, the underlying dynamics of the supply and demand of housing markets will be discussed. The thesis will then continue to describe the historical development for owner occupied housing of each capital as well as the development in the respective country as a whole. This is done so that the reader will gain an understanding of the current level of house prices in a historical setting.

From here, the thesis will continue with an empirical testing of the housing markets using traditional housing price models with the intent of identifying periods of overvaluation i.e signs of bubble tendencies. The applied housing price models will provide the thesis with an indication of whether housing prices are fairly priced according to theory.

Lastly, in order to provide a more reliable and thorough indication of the current state of the three Nordic housing markets, a comparative fundamental factor analysis will be conducted using several explanatory variables. This is necessary as the previous empirical housing price models do not allow the thesis to

sufficiently identify some of the criteria which researchers have determined to be conducive to housing bubble formation. Finally, a summary of the findings throughout the thesis is presented to the reader, as well as the assessment of the current state of the three housing markets.

2. Delimitations and Data

In the following section, the paper will outline its reasoning behind using the price measure of choice for housing to allow easy comparability. Moving on from this, it is outlined where the specific data has been attained from, and what time series the data sets will be used for. Lastly, the geographical area of each of the three cities is briefly defined. With regards to delimitations, these will be made throughout the paper and its analysis and so no specific section has been devoted to this.

2.1 Appropriate measure of house prices

While the predominant amount of price development research to date is conducted using a pricing index model, we have decided against obtaining pricing index data from the relevant statistical databases in showcasing the price development diagrams. We do recognize that price indices can indeed be beneficial when utilised at their most basic level such as in the retail space. However, we find that it becomes a much more complex measurement with housing. Retail indices measure a representative sample of retail goods. These goods are non-durable, meaning that they are consumed almost immediately. Housing, on the other hand is a durable good, that provides a flow of services (Chandler & Disney, 2014). There are two key aspects to housing in particular which results in indices differing. Firstly, dwellings are heterogeneous, meaning that they will differ in price depending on the properties' location and size. Consequently, indices which use sampled house prices may be a poor indicator of all house prices for that time period (Case & Watcher, 2005). Secondly, the turnover of different types of property differ from year to year. In other words, some types of housing are bought more frequently than others. These features mean that statistical databases can calculate their indices very differently from one another, meaning that the results can be mixed. For instance, they could potentially measure the average price of housing transacted over a specific period of time or alternatively measure the average price of the stock of housing at a given point in time (Chandler & Disney, 2014). For that reason, alternative housing indices have been developed, each of which is giving a different picture of the state of the housing market (Chandler & Disney, 2014).

One of the commonly used price indices is the representative-property method. This index defines a representative property, for example by the number of bedrooms, and then records the price in each period of a property conforming to these specified characteristics (Case & Wachter,2005). Thus, an index might

measure the price development of one-bedroom room apartments over time. One of the key problems of using this method is that the average size of one-bedroom apartments sold each year can undoubtedly differ depending on what is available on the market. This method would not factor in different sized apartments, and could produce skewed results. Additionally, by using an index method such as this one, and by focusing solely on the price of only one property type (the representative), it ignores the information in the prices of all other properties such as two-bedroom or three-bedroom apartments. Accordingly, it does not give a completely fair reflection of price levels, and in extreme cases it may not reveal the movements in the general price level if the representative in this case being one bedroom apartments does not respond in the same way as the other property types (Case & Wachter,2005).

In order for a comprehensive, simplistic, and comparable measurement tool between cities, we arrived at the conclusion that using a price per square metre metric was the best route forward. This price measurement is calculated by dividing the sales price, including the site value, by the useful floor space. While the housing on the market can be comparable in terms of characteristics like the number of bathrooms or bedrooms, the physical size can give a more accurate measurement.

2.2 Data

The data is collected by Finance Denmark and made available through DST. The house price data is based on completed transactions of properties and presented quarterly. The data is segmented between owner-occupied flats and one-family houses. The data examined throughout the thesis is between the first quarter of 1992 to the second quarter of 2018.

For Stockholm and Oslo, the examined housing price data dates from the first quarter of 1996 to the last quarter of 2017. The starting point of each house price data series was dictated by data availability.

The house price data from Stockholm and Oslo is obtained through Alfred Berg Asset Management, a Nordic asset manager within the BNP Paribas Group. Having come across a recent report of theirs on the Nordic housing market from March 2018, the authors of this thesis contacted the company directly which provided the thesis with the comprehensive data on both the Swedish and Norwegian markets. The asset management company compiled their data from Macrobond as well as local databases for housing prices.

For Sweden, the data is based on statistics from the company Mäklarstatistik, which collects data from the Swedish real estate agents. Our desired pricing per m^2 data on apartments and houses was available from 1996 until the fourth quarter of 2017. The data for the both the Swedish and Stockholm markets were calculated monthly. The thesis has then recalculated to quarterly data. For Norway and Oslo, the data from based on statistics from SSB and Real Estate Norway.

For all housing price data, nominal values are deflated using the respective countries quarterly CPI growth rate, given by OECD iLibrary (2018). Housing prices are generally stated in real terms and in local currencies (e.g. DKK, SEK and NOK). This is consistent throughout the thesis unless explicitly stated otherwise.

In the empirical analysis, detailed description of various data is presented in further detail.

Defined Geographical Area from which data is used

With regards to the geographical area of each of the three cities, we have attained the data from the following specific geographic areas:

-Copenhagen is delimited to the Province of Copenhagen city, which formally includes the municipalities of Copenhagen, Frederiksberg, Dragør and Tårnby. The volume composition of housing types differs greatly between the municipalities.

-Stockholm is defined as Stockholm county (Stockholms län) which is a county of Sweden which includes the municipality of Stockholm, and 25 surrounding municipalities.

-Oslo is defined as the municipality of Oslo (Oslo kommune)

3. Bubble theory

The purpose of this section is to provide the reader with an understanding of what a bubble is, and to establish what kind of bubble this paper is looking to identify. Firstly, the definition of a bubble and the factors that characterize it will be discussed. Furthermore, theories will be addressed outlining why housing bubbles transpire and burst, namely Hyman Minsky´s model and Case and Shiller's seven criteria.

3.1. The instability of financial markets

Several authors have contributed to the existing literature on housing bubbles (Shiller, 2006 & 2007; Krainer, 2003; Klein *et al.*, 2016) as the subject has gained interest as a result of fluctuating house prices and the increased trickling effects of the economic state of the housing market.

Financial crises are not by any means a new phenomenon in the history of the world economy as they have existed ever since the introduction of financial markets (Reinhart & Rogoff, 2009). A drastic and recent example of the impact of crashing financial markets on the real economy deliver, is the financial crisis in 2008 which originated from the sub-prime loan crisis and accompanied the American house market crash (Østrup *et al.*, 2009). However, the subject gained traction with economic scholars long before the recent

crash, as Hyman Minsky (1970 & 1977) developed the initial hypothesis of financial markets' cyclical behaviour and thus instability. He pioneered the literature on the capitalist economy by refuting the *neoclassical synthesis* and suggesting the economy can in fact be characterized as unstable. Minsky described and examined the economic consequences of the Wall Street board room view on the economy as a *'paper world'* determined by commitments to pay money today and in the future.

In the inception of his instability hypothesis, Hyman utilizes Michal Kalecki's (1976) simplified model of the consumption of goods. In this model, the total spending on consumer goods generates the mark-up on labour costs, which in turn yields the gross profit from operations, and exemplifies how the behaviour of financing and investment activities are determined by intricate relations. He asserts that this behaviour is largely dependent on the pace of investment and the assets ability to generate gross profit;

"the valuation that is placed on upon capital-assets, which determines current investment, and the ability to fulfil contractual commitments, which determines financing possibilities, depend critically upon the pace of gross profits" (Minsky, 1977)

In order to generate a gross profit, capital-assets are highly dependent on investments, and thus the causality of the relationship becomes apparent. This takes into account the relative scarcity of certain capital assets, e.g. houses. The subjective practice of valuing the asset further impacts the stability of the economy. The subjective nature of expectations can trigger an economy with stable growth into an investment boom, due to the interrelating effects described above. The expectations and attitudes of economic agents, i.e. financial institutions, ordinary business firms and also governments, seem to enforce this cyclicality by collectively accepting the economy is doing well and will continue to do so. This implicit confidence and maybe even complacency allow further risk taking and increased lending. This especially applies to banks and other financial institutions such as pension funds, hedge funds and insurance corporations, as increased borrowing and risk expands their financial reach, and thus has implications for the economy and society as a whole. In fact, recent developments arguably exemplify how financial institutions are exposed to the moral hazard of reaching a 'too big' or 'too important to fail' status ensuring them a bailout from government guarantees. Alongside this agency problem, in a positive economic market trend, financial institutions are encouraged to raise their leverage and invest in assets. They are incentivised to take on additional debt when asset prices increase as it will present the institutions with higher expected returns from their geared portfolio of investments.

Several governments were forced to cover banks losses and carry them through the recent global financial crisis. The tremendous losses were attributed to the financial institutions excessive gearing and complacent

inconsideration of the down side vulnerability of their investment activities. In America, widely accepted as the epicentre of the global crisis, the government bank bailout bill named 'Emergency Economic Stabilization Act of 2008' was signed by President Bush on October 8 2008. The bill devoted $700 billion dollars of taxpayer's money to bailout banks and other large corporations (The Balance, 2018). Simultaneously, Denmark experienced similar political readiness and approval. Between October 2008 and 2010, the Government introduced three 'bank packages' backed by a popular vote in the Danish Parliament (Nationalbanken, 2015a).

From the point of view of businesses and private consumers, this moral hazard issue and the general pro-cyclical tendency of increased risk-taking and lending materializes as a financial acceleration mechanism. In a growing economy, access to credit will be easier for both businesses and private consumers. Businesses can utilize this access to capital to create more jobs, which will lower unemployment and thus increase private income. People's increased credit availability and income will increase demand in the housing market leading to increased house prices. Higher house prices further fuels this relationship by allowing home owners to obtain more debt, using their increased household wealth as collateral.

Vice-versa, these spiralling effects would still hold true in the opposite market climate, being a pressed economy experiencing decreasing profits and investment levels. According to Minsky, these self-enforcing determinants of investment pace cause a de facto unstable economy;

"*a capitalist economy endogenously generates a financial structure which is susceptible to financial crisis and how the normal functioning of financial markets in the resulting boom economy will trigger a financial crisis"* (Minsky, 1977)

Without coining the term 'bubble', Minsky nods at financial markets tendency to pump up the market with new investments and increasing frequency, until the prices are so inflated that they no longer reasonably justify the real value of the assets, and the only possible reaction is the burst of the bubble.

3.2 Definition of a housing bubble

A formal definition of a bubble, and is speculative nature of conception, is given by Joseph Stiglitz (1990);

"if the reason that the price is high today is only because investors believe that the selling price will be high tomorrow – when 'fundamental' factors do not seem to justify such a price – then a bubble exists"

This paper adopts the above definition of a bubble, and will elaborate on the term and how to apply it specifically to housing markets, supported by extensive research and theories presented by Case & Shiller in the following section.

3.2.1 Case & Shiller's Criteria for a Housing Bubble

The authors Case & Shiller (2004) examined the effects of homebuyer's expectations. A general expectation of rising house prices will contribute to the development of bubble, when other fundamental factors fail to explain or justify the increase in prices. In correspondence with Minsky's view on financial markets being inherently unstable, Case & Shiller similarly argues that when expectations of rapid and steady future price increases are determinant motivational factors to homebuyer's, then the house prices are inherently unstable (Case & Shiller, 2004). Furthermore, an increase in house prices imposes a self-reinforcing effect as potential homebuyers may fear additional future increases which will result in them not being able to invest in a home. As a consequence, buyers fear the scenario of being priced out of the housing market if they choose to postpone their investment decision.

In summation, the authors identify 7 criteria that will support our definition of a bubble within a housing market:

The purchase of a property is viewed as an investment rather than a consumption good.

A firm belief of a sustained growth in future house prices.

A psychosocial pressure of being a homeowner.

The newsworthiness and media attention towards housing markets.

A limited understanding of the risk associated with homeownership.

An increasing house price to disposable income ratio.

A misconstrued understanding of the various mechanism that impact house price developments.

Considering the extensive literature (Shiller, 2000 & 2006; Case *et al.*, 2012; Kaplan *et al.*, 2017; Landvoigt, 2017) on the connection between individuals' behaviour and housing bubbles, it becomes apparent that the contributing factor to the instability of house markets are in fact *peoples' thinking*. In order for a bubble to be present, there needs to be a considerable discrepancy between the market value of houses and the house

prices determined by fundamental factors. Thus, the difference must be attributed to a variable of subjectivity and expectations of all actors involved in the housing market.

In addition, observers of housing markets must be aware of the fact that economic fundamentals also can be construed as unjustifiable. Thus, overvaluation of a housing market can be rooted in an unsound nature of fundamental factors and for example materialize as a result of an unsustainable level of income, extraordinary low interest rates and an unsound architecture for credit (Muellbauer, 2012).

4. Price Formations – Demand and supply for the housing market

Housing prices are affected by both the demand and supply of housing. The sellers of the housing stock represent the supply while the buyers of housing represent the demand. The primary role of the market price in the housing market is to establish an equilibrium between supply and demand. Unlike demand, the supply of housing is a factor of time, and as such it reacts slowly to changes in the demand for or price of housing. The housing stock is therefore generally quite stable in the short term because new housing generally requires extensive planning, permits need to be applied for and attained, and finally the new dwellings need to be constructed; three components which can take up considerable time. Additionally, the construction of new housing per year is low in comparison to the total housing stock (Jacobsen & Naug, 2005). Hence, in the short term, house price developments are predominately affected by demand only (Dam et al., 2011a). On the other hand, in the long term, housing supply will affect housing prices, which will be later discussed in detail in the supply of housing section.

4.1 The Demand of Housing

Housing demand consists of two different types of buyers:

1. Those who purchase it for consumption purposes as owner occupiers
2. Those who purchase it for investment purposes with the hope of achieving an attractive income return and/or an appreciation in value of the asset.

As per Jacobsen and Naug's model, it is justifiable to suggest that the first group is greater than the second, leading them to give a greater emphasis on the factors affecting the demand for owner occupied dwellings. By fixating on the demand for owner occupied dwellings, they also assume that this demand is proportional to housing demand.

As per their analysis, the aggregate demand function is given as follows:

(4.1) $$H^D = f\left(\frac{V}{P}, \frac{V}{HL}, Y, X\right), \qquad \frac{\delta f}{\delta\left(\frac{V}{P}\right)} < 0,\ \frac{\delta f}{\delta\left(\frac{V}{HL}\right)} < 0, \quad \frac{\delta f}{\delta Y} > 0$$

where:

H^D = Housing Demand

V = Total housing costs for a typical owner.

P = Index of prices for goods and services other than housing.

HL = Total housing costs for a typical tenant (rent).

Y = Households' real disposable income.

X = A vector of other fundamentals that affect housing demand.

The derivatives illustrate that housing demand decreases when the costs associated with ownership increase relative to the rent ($\frac{V}{HL}$) and/or relative to the price of other goods and services ($\frac{V}{P}$). Moreover, housing demand increases when income increases (Y). The vector X in this function captures the impact that additional fundamental factors have on housing demand. This X variable will be elaborated upon further in the comparative fundamental factor analysis in section 8 of the paper.

The four parts of equation (4.1) will now be elaborated upon further in order to give a more comprehensive understanding for the theoretical demand of housing. The first component of this being the real housing costs $\left(\frac{V}{P}\right)$ for owners is given by equation 2 below:

(4.1.1) $$\frac{V}{P} = \frac{PH}{P} BK = \frac{PH}{P}[i(1-\tau) - E\pi - (E\pi^{PH} - E\pi)],$$

where:

BK = Housing costs per real krone invested in a dwelling

PH = Price for an average dwelling (in kroner)

i = Nominal interest rate

t = Marginal tax rate on capital income and expenses

$E\pi$ = Expected inflation (the expected increase in P and HL, measured as a rate)

$E\pi^{PH}$ = Expected increase in PH

Firstly, it is important to note that the maintenance costs and tax advantages of owning a home have been excluded from equation (4.1.1). The real interest rate after-tax is given by the expression $[i(1-\tau) - E\pi]$. This calculates the real interest costs connected with owning a home, but also takes into consideration the

opportunity costs being the real interest income that is lost by investing in housing. Hence, an increase in the real interest rate represents higher costs of ownership and also higher opportunity costs since a higher return would have been achieved if the money was deposited. In addition, the expression $[E\pi^{PH} - E\pi]$ is the expected real increase in house prices. If this would increase in value, then so too would the expected housing wealth. Further, as a consequence of housing wealth increasing, the real housing costs would decrease. This results in $\left(\frac{V}{L}\right)$ also decreasing because housing costs are now relatively lower than before, meaning that it becomes more affordable to own than to rent housing. Consequently, housing demand would increase. The equation could further be simplified to the following:

(4.1.2) $$\frac{V}{P} = \frac{PH}{P} BK = \frac{PH}{P}[i(1-\tau) - E\pi^{PH}]$$

The third component of the initial equation (4.1) is disposable income (Y) and is given by Jacobsen and Naug as:

(4.1.3) $$Y = \frac{YN}{P^{a1}\, HL^{a2}\, PH^{a3}}, \qquad a^1 + a^2 + a^3 = 1, \qquad a^1 < \beta^1,\ a^2 < \beta^2$$

YN = Nominal Disposable Income
P = The General Increase in the Consumer Price Level
HL = Rent
PH = Price Level on Average Housing

Since these last three factors make up the denominator, an increase in the value of any of them would impact negatively on disposable income, reducing buyers purchasing power.

The final term of the equation (4.1) is the vector X. This takes into consideration the additional fundamental factors that impact housing demand. According to Jacobsen and Naug, these observable factors consist of demographic conditions, bank's lending policies, and household expectations regarding future income and housing costs.

Demographic conditions such as population size and growth, migration patterns, urbanization, and a reduction in the size of average households all play a role in increasing the demand for housing. The latter is linked to divorce rates, proving to be particularly relevant for the Scandinavian region, considering that Sweden and Denmark are among the top five countries in the EU with the highest divorce rates (OECD, 2016).

Banks' lending policies also hold significant influence since most home purchases are financed via a mortgage. Credit limits for example, place a cap on households' purchasing power, and by doing so can play

a part in restraining house price development. Despite this, banks will always consider the solvency of each borrower, and credit limits are in place for each individual assessment. The banks' policies and practices will depend heavily on the regulation in their respective country. Strict regulation can work to stifle demand. The opposite of this was seen in the Danish mortgage market. High Loan to Value (LTV) lending and long-maturity mortgage loans were two key aspects of Danish banks liberal policies. Additionally, despite house price increases over a sustained period, new financing initiatives were introduced in the form of adjustable-rate mortgages and deferred amortisation periods. This meant that borrowers had the possibility of reduced mortgage payments in the first year of their home purchase, and by doing so, it enabled more people to buy their own home (Dam *et al*., 2011a). This will be further elaborated in the credit policy section of the paper in section X.

The last factor in the vector X relates to households' future expectations regarding income and the costs associated with housing. The expectations of future income are linked to developments in the labour market since increasing unemployment levels leads to the belief that income will be lower in the future. Consequently, this will lead to greater uneasiness regarding households' future insolvency. This will affect households' ability to service debt, which in turn can leader to tougher regulations in the form of limited access to loan and credit access. Additionally, it can also reduce the appeal for households to buy housing since they now may more unwilling to take on risk with a more uncertain future ahead.

As aforementioned, Jacobsen and Naug specify various factors which influence the demand for housing. They point out that a positive and substantial change from the fundamental value is an indicator of a price bubble in the housing market. This bubble can occur not only by means of changes in fundamentals but also through positive shifts in price expectations. Subsequently, demand will increase and so too will prices with it. From this, price expectations can then continue to increase further, pushing up prices even more. Hence, this process can continue to such an extent that prices reach a level that is considerably above its fundamental value, creating a housing bubble.

4.2 The Supply of Housing

In the introduction of this section, it had been specified that the supply of housing differs in the short run to the long run, because new construction responds slowly to changes in demand. While the construction of the buildings takes considerable time, the process also requires lengthy planning, with permit application also prolonging the process. Accordingly, it is practical to distinguish between the supply of housing in the short-run and long-run. Hendry's model (1984) is a good starting point to discuss this development of the housing stock. It is presented as follows:

$$(4.2) \qquad H_t = (1 - \delta_t)H_{t-1} + c_t$$

Where:

H_t = The Housing Stock in period t

δ = The depreciation rate of the current housing stock

H_{t-1} = The Housing stock in the previous period

c_t = The Number of Net Housing Additions in period t

As per this equation, the present housing depends on the previous periods housing stock, adjusted for depreciation, plus net housing additions. These net housing additions consist of the new housing constructions minus the houses that have fallen out of the market by means of demolition, renovation, changed use of building etc.. It is assumed, however, that the housing supply is perfectly inelastic in the short run, and so depreciation and new housing are considered negligible in the short run.

Before going into detail about the short and long run equilibrium of housing, it is first of all necessary to acknowledge the factors that influence the level of new constructions. While it is true that the price of the existing housing stock will influence the prices of new housing since they are assumed to be close substitutes, there are further factors that come into play. These include the property cost, the construction cost, building regulations, infrastructure, and the expectations of future house prices.

The property costs comprise of the cost of land and/or property. Generally speaking, urban areas tend to have higher growth in housing prices than rural remote areas. This is on account of these areas being more densely populated, where land is scarcer. It is interesting to compare Copenhagen, Oslo and Stockholm in this regard. Copenhagen's geography means that it has the possibility of building in several directions, which can help in curtailing price increases. Oslo and Stockholm, on the other hand are more geographically restricted, meaning that there is limited space for new buildings. Oslo, for instance is surrounded by mountains, making it difficult to expand outwards which results in higher construction costs (Nissen *et al.*, 2013). From this, it can be argued that in metropolitan areas, the access to land determines new housing prices more so than the construction cost of the building itself. For the construction cost will depend on the specific housing requirements, the factor price of labour and materials, along with the productivity within the construction sector.

The regulatory limits on the height and density of buildings further constricts supply and inflates price levels (The Economist, 2015). In the centre of Copenhagen, unlike most capital cities, there are very few buildings that are more than six storeys high. As many of these buildings are primarily historic, they have been deliberately retained, and are protected by planning laws. Further, the quality and level of public infrastructure in place also plays a role for property costs. Taking Copenhagen as an example again, the announcement of expanding cities popular metro network to areas such as Nørrebro, Østerbro and Nordhavn has surely played some part in these areas price increase over the last few years. Announcements like this

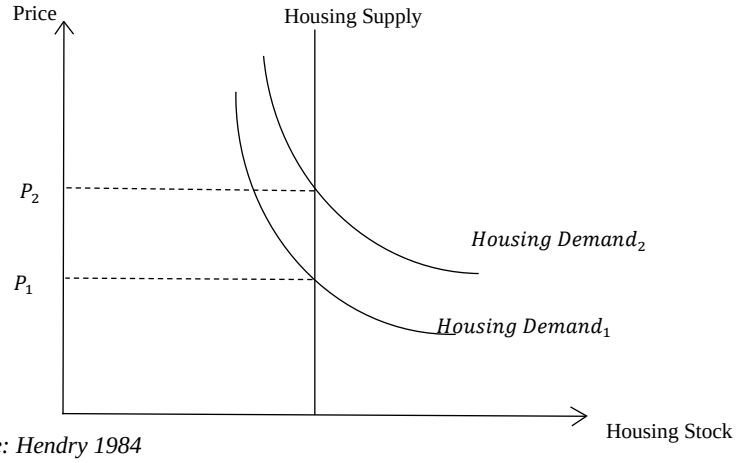
also incentivize individuals to increase the supply of housing in these areas, as the prices would be expected to increase in the future. Nordhavn has seen a major transformation in this regard, remoulding itself from an active industrial port to being a modern residential and business area. Once completed, the area will home more than 40,000 residents. Other notable areas of development include Carlsberg Byen and Sluseholmen, both also of which are former industrial areas

Lastly, many building projects end up facing cost overruns or delays as a result of poor construction productivity. As per research from McKinsey, construction productivity has been flat for decades, in comparison to manufacturing where manufacturing has nearly doubled over the same period (McKinsey & Company, 2015). A variety of factors could explain this inefficient productivity levels such as poor organization and planning, flawed performance management, or potentially contractual misunderstandings. Regardless, the implications are severe as the original cost estimate may end up being a mere fraction of the final costs.

4.3 Short Run Equilibrium

The short run is defined by Jacobsen and Naug as being a period of two to three years. In the short run, the supply curve will be inelastic, meaning that any changes in price will transpire through changes in the demand curve only (Hendry, 1984). Hence, prices in the short term are determined by those factors which shape demand. Increased price levels are thus driven by increased disposable income, decreased housing costs relative to rent or relative to the price of other goods and services, and lastly through changes in the vector X.

Figure 0-1 - Short Run Equilibrium in the Housing Market



Source: Hendry 1984

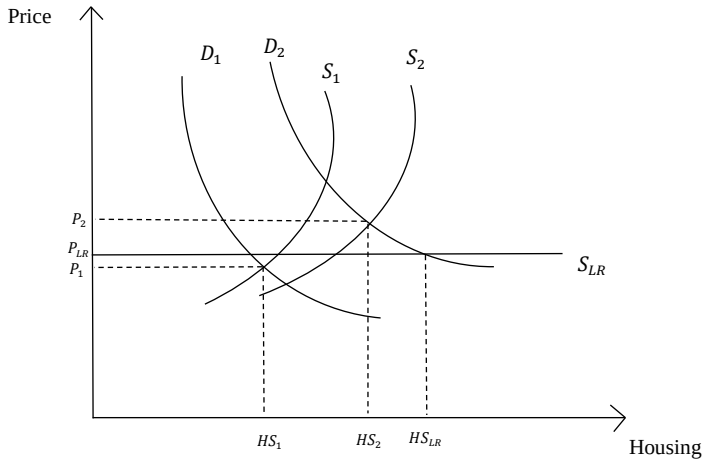
A price that differs from the equilibrium price level can occur as a result of an excess demand for housing or from an excess supply of housing. In this case, since supply is fixed in the short term, a small unexpected

change in demand can result in a significant increase in the housing price level, pointing out the relatively large volatility in house prices in the short term. As illustrated in the figure above, the initial equilibrium price level is at P_1. An increase in demand shifts the demand curve outwards from $Housing\ Demand_1$ to $Housing\ Demand_2$. With this, it also pushes the price level upwards from P_1 to P_2. Here, demand has exceeded supply, which led to increased prices. Home buyers' willingness to pay has increased, as only those people who will be able to afford the price level P_2 will now be able to purchase housing.

4.4 Long Term equilibrium

In the long run, assumed to be infinite, housing supply will adapt to demand. As increased housing demand leads to increased housing prices, the higher profitability of new housing projects relative to other goods and services will entice construction firms into increasing the supply of housing units. This is based on the premise that house prices will exceed the construction costs. Accordingly, in the medium term, housing stock can increase if the increase in new housing exceeds the depreciation of the current housing stock. As the supply curves shifts to the right, it becomes more elastic, as the increased supply restrains the price increases. Increasing supply will continue until the marginal cost of construction equals the housing price. Consequently, the price elasticity of supply will become perfectly elastic in the long run. As Hendry (1984) alludes to, the long run equilibrium could resemble a stable state in which construction firms earn normal profits, where the amount of new housing is equal to the depreciation of the housing stock.

Figure 0-2 Long Run Equilibrium in the Housing Market



Source: Hendry 1984

As per figure 0-2, we see that the equilibrium in the medium term is at the intersect between S_1 and D_1 at a price of P_1 with a housing stock of HS_1. In contrast, the equilibrium price in the long run is the intersect between S_{LR} and D_1. Following an unexpected increase in demand in the medium term, construction firms will adjust by increasing supply to stifle the price increases, and a new equilibrium will be formed at the

intersect between S_2 and D_2 at a price of P_2 with an increased housing stock of HS_2. Assuming that there are no restrictions on the construction of new housing, supply will continue to increase to adjust to demand, until the marginal revenue of housing constructions equals the housing price i.e at a level in which construction companies earn zero profits. At this point, the long run equilibrium will be established, in which there would be no disparity between the demand and supplied stock of housing. Consequently, in the long run, new construction only takes place in order to replace existing housing which had depreciated (DiPasquale & Wheaton, 1996).

It is necessary, however, to question the above assumption regarding there being no restrictions on the availability of new sites to build upon. For, in urban areas, which is the focus of this paper, one could argue that land scarcity could prove decisive in the long run, as at some stage the supply of housing may reach a tipping point whereby it would no longer be able to adapt to demand. This is dependent on the geographical restriction on cities' ability to build outwards, which clearly varies from city to city. In Oslo's case, the above supply model may not be feasible, as the cities' geographical restriction would suggest that there is clearly a limited area of available land to build upon. For that reason, the housing supply in the future could potentially reach its maximum capacity or threshold, and from thereon out, the price development would be driven by the demand side only.

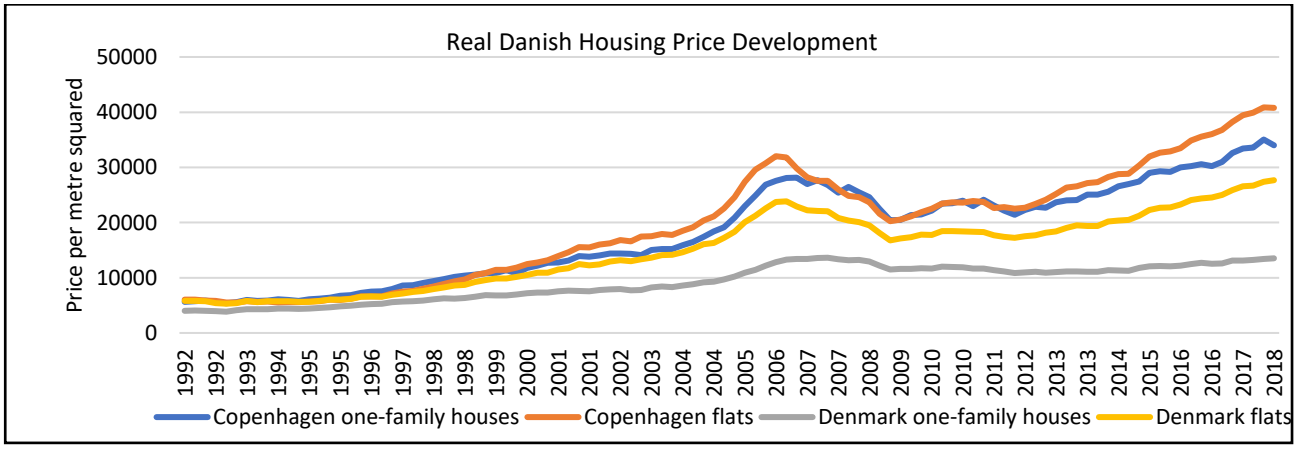
5. Historical Price Development

In order to gain a greater understanding of the current situation in the three Nordic capital housing, it is useful to analyse the historical price development that has been witnessed up until today. This will enable the reader to recognize the housing peaks and troughs in the past and determine the factors that influenced them. It can prove beneficial for the research question as it will help in understanding how the market's past behaviour relates to its future. As this paper also involves a comparison with the other Nordic capitals, Oslo and Stockholm, the paper will also look at their price development. The price development of each country as a whole will further be included as a means of benchmarking the price development of each of the capital cities with their respective national average. Furthermore, it should be noted that housing will be categorised under two groups of owner-occupied dwellings: one-family houses and flats in Copenhagen. For Oslo and Stockholm, it will be under owner-occupied houses and flats due to data availability.

5.1 Denmark and the Copenhagen Housing Market

Through Finance Denmark, historical data was obtained on the nominal price development per m^2 of housing in Copenhagen and Denmark. The nominal house prices have been deflated using the CPI for Denmark. The pricing was calculated quarterly and the data provided was from the first quarter of 1992 until the second quarter of 2018. The house prices are stated in local currency (DKK).

Figure 0-3 - Danish Housing Price Development



Sources: Finance Denmark and *the OECD iLibrary*

It was over a thirteen-year period from 1993 until the price peaks of 2006 in which Copenhagen experienced a housing boom which would later prove to have disastrous consequences. From the first quarter of 1993 until the second quarter of 2006, the prices of one-family houses and owner-occupied flats in Copenhagen increased by 462% and 529% respectively. In comparison, at national level, the price increases were 224% and 354% over the same period.

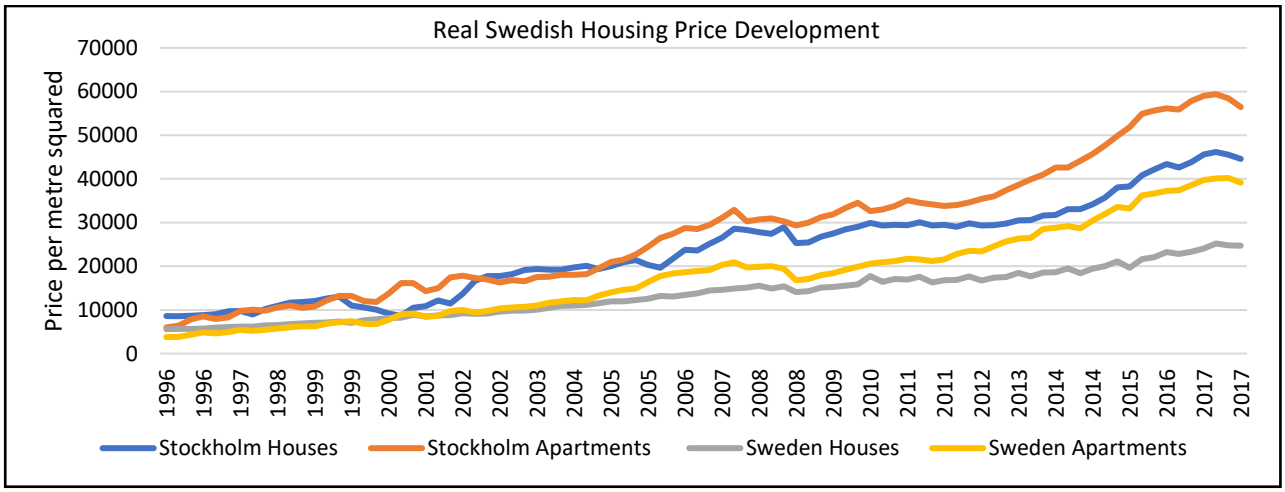
The pricing growth was particularly excessive over a 3-year period of housing hysteria. Between the period of 2003Q1 to 2006Q2, Danish housing prices witnessed exceptionally large price increases. The prices of one-family houses and owner-occupied flats in Copenhagen increased by 95% and 83% over this period, and at a national level the increases were 65% and 78% respectively.

This excessive growth did not generally reflect sustainable development and it was not long until these steep price increases were being reversed at a high speed. From 2006Q3 until 2009Q1, the housing bubble burst as the prices of one-family houses and owner-occupied flats in Copenhagen declined by 27% and 36%, compared to a national level of 14% and 30%.

5.2 Sweden & Stockholm

In Figure 0-4, the real housing price development for Sweden and Stockholm is illustrated from 1996Q1 to 2017Q4.

Figure 0-4 - Swedish Housing Price Development



Sources: Alfred Berg Asset Management and the OECD iLibrary

Sweden experienced similar house price developments to Denmark up until the Financial Crisis in 2008. Over a ten-year period from 1997Q1 until 2007Q4, the prices of houses and apartments in Stockholm more than tripled, increasing by 212% and 283% respectively. Perhaps surprisingly, however, was that the growth of apartment prices on a national level eclipsed this over the same period, accumulating 326% growth. In comparison, the growth in house prices on a national level was at a lower 153% level.

While Denmark witnessed its housing boom over a 3-year period from 2003 until 2006 in particular, the pricing growth in Stockholm and Sweden grew at a much more stable level, as can be seen in figure 0-4. Moreover, while the global financial crisis brought about a sharp house price correction in the Danish housing market, it was far less severe in the Swedish market. For, by 2010, the Stockholm and national level prices for both apartment and houses had surpassed their pre-crisis peaks.

In the years that followed, particularly from 2012 until 2016, the housing market continued to show great promise. The year on year growth was most substantial in December 2015, at which point apartment prices

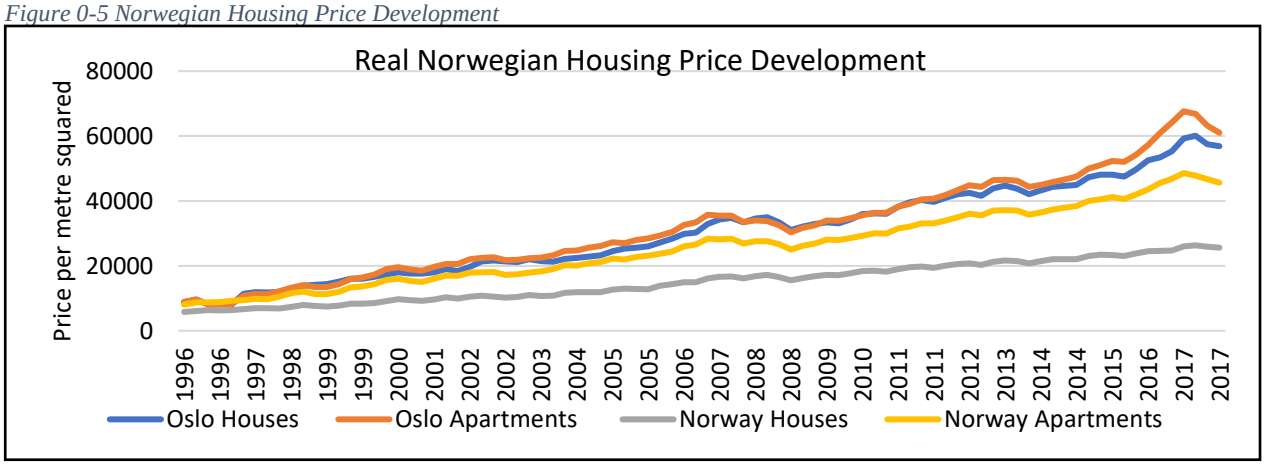
in Stockholm & Sweden had risen 20% from the year prior, while house prices in the capital had witnessed a resounding 22% growth over a year, while the figure was significantly lower at a national level at 12.5%.

This proved to be a critical juncture as prices from there on in started to slow down significantly in the months and years that followed. By April 2017, the year on year growth had dropped to 6% and 5.5% for apartments and housing in Stockholm, compared to a national level of 8% in both categories. This slowdown was amplified when housing price growth turned negative by the following month. From May until December 2017, apartment and housing prices in Stockholm diminished by 8.5% and 7.25% respectively, while at a national level the decreases were at a 5,9% and 5,3% level. This slowdown in the Swedish housing market represented the biggest overall drop in housing prices since the Financial Crisis. After an almost two-decade long period in which housing prices were on an upward trend, during which the country sailed through the Financial Crisis largely unscathed, the cracks now appeared to be showing.

5.3 Norway & Oslo

In Figure 0-5, the real housing price development for Norway and Oslo is illustrated from 1996Q1 to 2017Q4.

Figure 0-5 Norwegian Housing Price Development



Sources: Alfred Berg Asset Management and the OECD iLibrary

Similar to the Swedish market, Norway underwent steady but considerable housing price expansion from 1997Q1 until 2008Q2. During that period, the prices of houses and apartments appreciated by 333% and 309% respectively compared to the national levels of 169% and 198%. Again, akin to the Swedish market, the housing price dip that followed was mild and short-lived. For prices started to fall after August 2007 and continued to do so until December 2008. Over that brief period, the prices of apartments and houses in Oslo dropped by 15.9% and 12.3%, while at a national level the figures were at 13.1% and 9%.

In the subsequent years, prices re-commenced their ascendance with prices surpassing their peak pre-crisis levels by mid-2010. Up until 2016, the housing market witnessed year on year pricing growth, with the exception of the year 2013 whereby minor pricing drops were experienced. From 2009 until the end of 2015, apartments and houses in Oslo endured a price ascent of 69% and 51%, while at a national level it was lower at 60% and 45%.

It was most notably in 2016 whereby Oslo went through its most exceptional price increases. Over just a 12-month period, apartment and housing prices appreciated by a resounding 23.6% and 18% respectively in the nation's capital. However, it was not long after this that prices began to take a turn for the worst as price declines were witnessed in Oslo in September 2017 and persisted in the coming months. In the last four months of the year, prices for apartments and houses declined by 4.6% and 1.9%. While the declines may be perceived as only minor and short sighted, the implications have started to look more severe, with the market reverse driving the Norwegian kroner to an almost record all-time low in December 2017 (Bloomberg, 2018b).

6. Empirical Analysis

This section of the paper will investigate the first sub-question of the thesis' problem statement, by conducting an empirical analysis of the owner-occupied housing markets of the three Scandinavian capitals. The section will include two traditional house pricing models that will be thoroughly introduced to the reader. Discussion of the models' general limitations as well as their ability to identify housing bubbles will be presented. The respective models included in the empirical analysis are the Hodrick-Prescott (HP) filter and the Price-to-Income ratio. These are included as they examine some of the underlying factors that are important to the development of housing prices. The latter model will provide the bulk of the empirical analysis in this thesis. The extensive P/I ratio analysis incorporates effective property tax rates that are estimated and analysed in Housing Taxation section 8.XX in the comparative fundamental factor analysis.

6.1 Hodrick-Prescott Filter

International research on European housing markets chiefly agree that real house prices in the long run have an equilibrium price founded in fundamental values (Girouard *et al,* 2006; Bergman *et al.*, 2013; André, 2010; André *et al*., 2014).

In order to further examine the development of the housing market over time, the thesis will apply the HP filter to analyse differences between the long-term equilibrium and real housing prices in the market. According to Grytten (2009) such an analysis can help uncover trends, fluctuations and any deviations from the underlying trend that could indicate bubble tendencies in the housing market. Thus, we find it relevant to include this model in our analysis to help thoroughly answer our research question.

6.1.1 Theoretical framework

Originally developed by Robert J. Hodrick and Edward C. Prescott in 1981, the Hodrick-Prescott filter is a mathematical formula designed to analyse fluctuation in economic activity and estimate long-term trend components of a time series. By decomposing a given data series into trend and cycle components, the model can determine the value of the trend (t_t) which will minimize the deviation (c_t) between the observed value and the trend. In the context of this paper, we will be using the model to determine any possible indication of the housing prices being under- or overestimated to help answer whether or not a housing bubble is present.

As stated in Hodrick and Prescott (1997), the model assumes that a given time series (y_t) is the sum of a cyclical component (c_t) and a trend component (t_t), as presented in the following equation:

(6.1.1) $$y_t = t_t + c_t \qquad \text{For } t = 1, \ldots\ldots, T.$$

Where

(6.1.2) $$c_t = y_t - t_t$$

As mentioned, c_t represent the cycle component and will measure the strength of a given business cycle, possibly causing a deviation between the long-term equilibrium prices and real housing prices in the market.

Further, the objective HP-filtered function can be used to determine the long-term trend component of a time series by minimizing the following equation:

(6.1.3) $$HP_t = \left\{\min \sum_{t=1}^{T} c_t^2 + \lambda \sum_{t=2}^{T-1} \left((t_{t+1} - t_t) - (t_t - t_{t-1})\right)^2\right\}$$

In this analysis, *T* is the number of observations for house prices, i.e. the number of quarters in each time series of housing price data for each capital. The first part of the equation above represents the squared deviation between the observed value and the trend. The equation is squared in order to equally emphasize negative and positive deviations, since both positive and negative bubbles can occur. The second part of the equation above measures the change in trend from one period to another, and is weighted by the smoothing parameter λ. The lambda parameter is a value between 0 and ∞ and is used to determine to what extent variations are allowed in the trend. When lambda equals 0, the trend component will be equal to the observed time series. As lambda approaches ∞, we will see the trend become gradually linear. The second part of the equation lapses when lambda equals 0, which means only the observed value and trend are minimized. The ideal condition would be $c_t = 0$, when the deviation between the observed value and trend is zero. However, it is unrealistic to expect as that would imply that business cycles do not exist. Thus, if the cycle component is different from zero $(c_t \neq 0)$, then the empirical model will indicate a possibility of under- or overvaluation.

Alternatively, if lambda approaches infinity the result would be that the last part of the equation has all the weight and the trend becomes increasingly linear. This is also an unrealistic outcome, as that would mean there is a constant linear growth rate in the market.
If the real house price exceeds the HP trend in a given observation it will indicate house prices are overvalued and vice versa.

6.1.2 Model Limitations

Due to the simplistic nature of the HP-filter, there are a number of weaknesses worth noting when using the model. Most significantly, it can be argued that the model lacks fundamental strength as it simply considers the trend of observation without any economic rationale behind it. Thus, any major fundamental changes in the market will simply present as an over- or under-pricing even though that is not the case.

The model is considered a helpful tool when measuring deviations from trend, but before drawing any conclusions from its results we will be highlighting its most central shortcomings below.

1. The choice of the lambda parameter

When using the model, one should be aware of the influence the choice of lambda will have on the output of the model. Since the lambda value is discretionary, the chosen value is bound to manipulate the analysis and its results to a great extent. Hodrick and Prescott (1997) recommends to set the smoothening parameter, lambda, to equal 1.600 for analysing quarterly data. However, an empirical study performed by Borio & Lowe (2004) find that choosing a significantly higher smoothing parameter of 400.000 on quarterly figures will make the test perform better. This will make the identified trend considerably more smoothened compared to the normal parameter choice of 1.600 as it will improve the model's ability to capture low-frequency and cumulative deviations, as well as impose more weight on the mean reversion tendency of the trend in the HP-filter (Borio & Lowe, 2004).

Hence, this parameter value is chosen in the thesis empirical HP-filter analysis of real house prices in all three Scandinavian capitals. The subjective and arbitrary choice of lambda highlights the parameter's manipulative attribute and a considerable weakness in the model. The analysis will later comment on how this may impact results.

2. Challenges in model endpoints

In order to determine the trend in a time series, the HP-filter uses previous, current and future observations. It can therefore be seen as a two-sided model, which causes problems in the formula's end-point values. At either end of a time series, only the future or previous values are present, and if either of these observed values are uncertain it can become a challenge for the analysis. As a result, the beginning and end of the time series become more heavily affected by the current observations. Therefore, the model moves from being

two-sided to being one-sided and putting too much emphasis on the most recent observations. This can be considered a major point of criticism, especially when analysing the housing market and trying to determine whether or not a housing bubble is present.

3. The filter's interpretation of long cycles

When using the HP filter in analysis, it is worth noting that there is a possibility that longer cycles will affect results and generate wrong outcomes. The filter adjusts potential prices up and down during cyclical fluctuations and can mistakenly identify long cycles as a trend. Additionally, a long-lasting negative deviation from the trend can appear as a declining trend, which is not always the case.

4. Positive and negative cycle components have equal weight

As mentioned previously, positive and negative deviations are given equal weight in the model. This implies that the average up- and downturns in the economy last the same amount of time. However, Cristina D. Romer (1999) argues that this is not the case. According to Romer's research, upturn lifecycles last longer and therefore the model might produce misleading results by giving the two-equal weight.

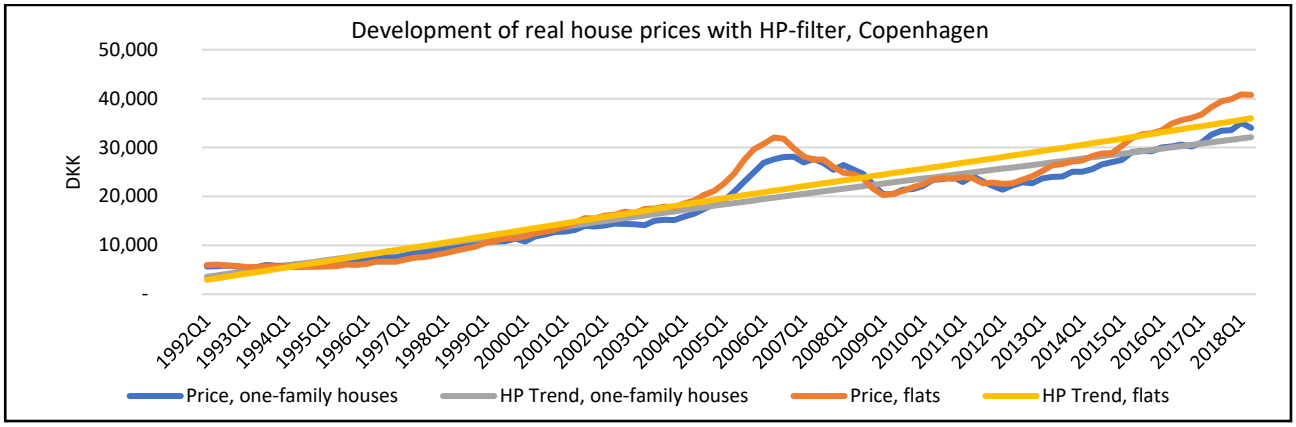
6.1.3 Real house prices with HP-filter and HP cycle effects

Adding a HP-filter to the development of real house prices is interesting as it will stretch and even out the time series data, so that possible frictions or 'noise' from the trend is removed. The filtered house prices can be considered as a moving centralised average, that ensure that future expectations on house prices rely on a smoothened historical average rather than possible random fluctuations in house prices. Therefore, the HP-filter is added and illustrated with the development of real house prices for each capital.

6.1.4 Copenhagen

Figure 0-6 illustrates the development between 1992Q1 and 2018Q2 of real house prices for one-family houses and flats in Copenhagen with added HP-filter to the respective time series. The HP trend component is calculated in Excel using an add-in module. The two trend lines in the above graph are estimated using a lambda value of 400.000. See appendix 6.1 for an overview of calculations.

Figure 0-6 - Development of real house prices for Copenhagen with HP-filter



Sources: Finance Denmark and OECD iLibrary

The development of the two trend lines illustrated above indicate only minor instances of over and undervaluation of house prices in the first half of the examined time period.

From 2004 and 2008, figure 0-6 clearly illustrates an overvaluation of house prices in Copenhagen prior to the financial crisis. The deviation between the trend line and real house prices is particularly strong for flats. Furthermore, the development indicates earlier signs of a housing bubble for this type of dwelling compared to one-family house.

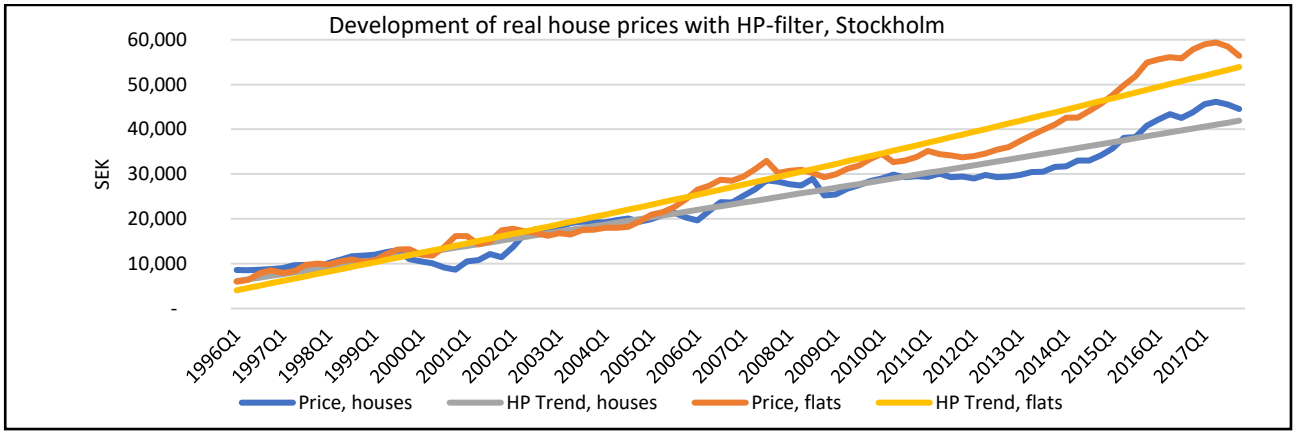
Post-crisis, real house prices lie below their respective trend line indicating that prices are undervalued. In recent observations, specifically since 2016, real prices for flats exceeds the long- term trend and thus signalling that a housing bubble is currently present in Copenhagen. The deviation is subtler in the case of one-family house but the development also indicates bubble tendencies today for this type of dwelling. persistent for flats.

The argumentation above is further supported by the development in HP cycle effects deviation from the trend line illustrated in appendix 6.2.

6.1.5 Stockholm

Figure 0-7 illustrates the development between 1992Q1 and 2017Q4 of real house prices for houses and flats in Stockholm. The illustrated HP-filters are estimated using a lambda value of 400.000, calculated as shown in appendix 6.3.

Figure 0-7 - Development of real house prices for Stockholm with HP-filter



Sources: Alfred Berg Asset Management and OECD iLibrary

The trend lines plotted in the graph above indicates that house prices in Stockholm was modestly overvalued from 2006 and leading up to the global financial crisis in the end of 2008. However, the price of houses in Stockholm deviate from its HP trend between 2000 and 2002 and indicating that prices were undervalued.

As mentioned earlier in the historical development of Stockholm and Sweden, houses prices in Stockholm experienced a rapid post crisis growth. Despite this rapid growth, figure 0-7 illustrates that real house prices were noticeably undervalued between 2011 and 2015. Evidently this identified deviation may not be completely reliable due to the endpoint problems as discussed in the limitations of the HP filter. Because the HP trend is not based on future house prices that lie ahead of the examined time period in this empirical testing, the trend in the recent observations will be highly impacted by the rapid house price growth the Stockholm housing market experienced between 2012 and up to 2017Q2. The analysis has attempted to mitigate the effects of this limitation by applying an abnormally high smoothening parameter of 400.000. However, endpoint problems still seem to be still present.

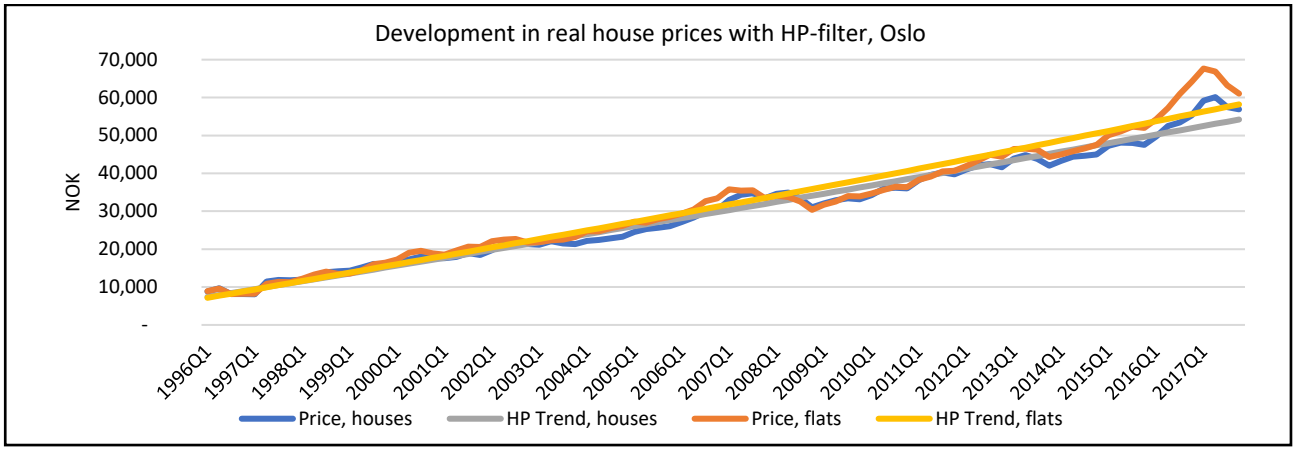
According to the trend lines, house and flat prices in Stockholm have been considerably overvalued since 2015Q3 and 2015Q1, respectively. However, the recent real house price correction in Stockholm have narrowed the gap significantly, the deviation still imply that bubble tendencies are present.

The gap in the HP cycle component from the trend is illustrated in appendix 6.4 and highlights the development outlined above.

6.1.6 Oslo

Figure 0-8 illustrates the development between 1992Q1 and 2017Q4 of real house prices for houses and flats in Oslo with HP-filter to the respective time series.

Figure 0-8 - Development of real house prices for Oslo with HP-filter



Sources: Alfred Berg Asset Management and OECD iLibrary

Compared to the empirical testing of Copenhagen and Stockholm, house prices for dwellings in Oslo moves closely to the estimated HP trend. Thus, figure 0-8 only illustrate few and modest instances of under- and overvaluation, except for the most recent observation. As was the case in the analysis of Stockholm endpoint challenges also seems to impact the model's results for Oslo. Nevertheless, the large gap between 2016 and 2017 strongly indicate that prices of flats in Oslo are overvalued. The gap more modest for the development in real prices of houses.

Despite the fact that a recent house price correction in Oslo have caused the development of the house prices and trend to converge, the analysis indicates considerable overvaluation of flats in 2017Q4. This interpretation is support by the graphical illustration of the identified gap between the HP cycle effects relative to the HP trend illustrated in appendix 6.5.

6.1.7 Conclusion

The empirical testing of the development of real house prices with a HP-filter have assisted the thesis with identifying periods of possible overvaluation in the three housing markets. The HP model provided a clear indication of overvaluation in Copenhagen leading up to financial crisis. During this period, indications of under and overvaluation in the two other Scandinavian capital were less clear. Furthermore, significant endpoint problems due to a prolonged steady growth in the three housing markets seems to impact the model results. This is in spite of an abnormally high smoothening parameter.

As argued under the limitations of the HP-filter, there are significant shortcomings that impact the model's results. Nevertheless, the development of real house prices with a HP-filter indicate a house price bubble currently in the most recent observations of all Scandinavian housing markets. Indications are stronger for prices of flats compared to houses. However, empirical testing using an alternative house price model that

includes underlying factors shown to impact house price development will have to be conducted. This will provide the thesis will a better understanding of the drivers behind the identified gaps.

6.2 Price-to-Income ratio

According to Case & Shiller (2004) a defining characteristic of a housing bubble is an increasing house price to income ratio. An increasing ratio will be interpreted as housing becoming less affordable to individuals due to an asymmetrical development between house prices and disposable income. This is because housing investments are primarily financed through mortgage loans, which are serviced through paying instalments and interest from a households' incomes. As these mortgages are approved based on the debt level relative to the size of the household's disposable income level, problems can arise for households if the costs of housing (instalments and interest expenses) increases more than the household's disposable income (Røed Larsen, 2005). As such, if house prices outpace the increase in income, it will then become more difficult for individuals to finance a house purchase, in terms of receiving the necessary approval from credit institutions. Thereby, it is relevant to analyse the historical development of the house price to income ratio and examine whether changes in affordability would indicate bubble tendencies.

The P/I ratio is theoretically founded from the price to earnings and price to rent ratio and therefore a review of the theoretical framework behind the ratios will commence this empirical analysis.

6.2.1 Price-Earnings and Price-to-Rent ratio

The basic approach of the Price-Earnings (P/E) model was introduced by Gordon and Shapiro (1956) who described a systematic method of analysing and selecting investment opportunities. Their intuition was elaborated by Miller & Modigliani (1961) as a pricing model of stocks, commonly used by analysts and investors today. The Price-to-Dividend ratio can be applied as a multiple to calculate a theoretical value of a given company, derived as the stock's current price per share measured against earnings per share (Bodie *et al.*, 2013). Put in different terms, the ratio indicates how much investors are willing to pay to gain access to 1 unit of earnings on a yearly return basis.

At first glance, the P/E pricing model as an investment decision metric can seem difficult to apply when judging the state of a housing market. However, by adopting this asset pricing approach house prices are viewed in relation to the cost of renting a house. Looking at the cost of owning versus the cost of renting provides a measure that, to a limited extent, can assess whether house prices are 'too high or low'. According

to Krainer (2003) signs of an existing bubble in the housing market are found when a long-term deviation is present between the market price and the fundamental value of the house price.

Further elaborating the framework, we can transform it to describe the house price (P) against the cost of renting a home (R), as opposed to earnings in the traditional model. The Price-to-Rent (P/R) ratio adopts an opportunity cost perspective, reflecting the decision that potential homeowners are faced with when they decide to either buy or rent a dwelling. From a current home owner's perspective, the opportunity cost reflects the forgone income from renting the dwelling to a tenant. Vice versa, a tenant currently renting a dwelling is faced with the alternative of buying a home, effectively transforming his or her rental cost to an investment with adherent financing costs. This relationship is expressed as the P/R ratio, given by equation:

(6.2.1) $$\frac{P}{R} = \frac{House\ price}{Annual\ rent}$$

Looking at the historical development of the P/R ratio on a standalone basis will not provide the thesis with a sufficient indication of house prices are too high or low. In order to determine if it is economically more attractive to rent or own a home, one has to look at the annual user cost of owning a home, given by the following equation (Poterba, 1992):

(6.2.2) $$Annual\ user\ cost\ of\ owning = R = \left[i + \pi_p + \beta + m + \delta - \pi\right]P_H$$

Where:

$R = annual\ user\ cost\ of\ owning$

$P_H = nominal\ house\ price$

$i_a = nominal\ mortgage\ interest\ rate\ (after\ tax)$

$\pi_p = property\ taxes$

$\beta = risk\ premium$

$m = maintenance\ costs$

$\delta = depreciation$

$\pi = expected\ capital\ gain/loss$

The user cost related to owning a house (R) is calculated as the sum of opportunity costs which is comprised by six components that represents both offsetting and beneficial effects. A higher user cost could be triggered by an increase in either the nominal after-tax interest rate(i_a), property taxes (π_p), maintenance (m), depreciation (δ) and in the risk premium that is derived from the higher risk of owning a house compared to renting (β).

In equilibrium, the equation will have to satisfy that the net income from homeownership will equal zero. Therefore, an increase in five of the aforementioned factors will result in a decrease of home owner's nominal capital gain (Poterba, 1992). The expression also illustrates how the house price (P_H) will appreciate with an increase in the inflation rate (π), benefitting the home owner's nominal capital gain (Henderschott & Slemrod, 1983).

In the short-term, imbalance between rental cost and user cost of owning will push the housing market into disequilibrium. Suppose it is cheaper to rent a dwelling compared to owning a home, then rational behaviour will entice an increase in demand of rentable housing. In the short-term, equation (6.2.2) accordingly captures the shift in demand through a decrease in house prices. Although, theoretically the house market will move towards equilibrium in the long-term as ratios seem to be reverting to their long-term average value (André *et al.*, 2014). This means that the economic incentive for renting an occupation will be evened out in the long-term by increasing rental prices and/or decreasing house prices.

By rearranging the house price (P_H) together with the expression for the user cost of owning (R), the thesis arrives at the equation for the fundamental house-price-to-rent ratio:

(6.2.3) $$\frac{P_H}{R} = \frac{1}{\left[i_a + \pi_p + \beta + m + \delta - \pi\right]}$$ = User cost of owner-occupied dwelling

The right side of equation (6.2.3) represent the long-term fundamental relationship between house prices and rental cost. In theory, the housing market is priced correctly, i.e. in equilibrium, when the expected annual cost of homeownership does not exceed the implied annual cost of renting (Himmelberg *et al.*, 2005). If the P/R ratio exceeds its own long-term average value it could indicate that bubble tendencies are present in the market.

As expressed in equation (6.2.3) the relationship is affected by the development of explanatory fundamental factors such as the interest rate. Fluctuations in interest rate levels will correspond to a change in the after-tax mortgage interest rate, *ia*. The impact on the average mortgage interest rate depends on the aggregated portfolio of mortgages within a housing market, subject to the maturities of the loans, how often they are refinancing and the composition of the repayment profiles. Interest rate hikes will affect house prices through several dynamics. This will to some extent cause the fundamental P/R ratio to follow macroeconomic trends and the general trajectory of the economy. As a result, an increasing or decreasing P/R ratio does not unambiguously support the indication that houses prices are respectively priced too low or high. If the market experiences increasing interest rates, the user cost of owning a house will also increase, which in turn will weaken demand and result in lower house prices. Thus, the relevant criterion to asses becomes the inter-development between the actual P/R ratio (equation 6.2.1) and the fundamental P/R ratio (equation 6.2.3). The fundamental P/R ratio provides an indication of what the actual P/R should equal in the equilibrium state, as it reflects the development of underlying economic factors in the same time period. If there are significant deviations present between the actual and fundamental P/R ratio it is an indication of a bubble formation in the housing market (Girouard *et al.*, 2006).

Lastly, the model assumes perfect arbitrage between owning and renting a house, causing a caveat in its analytical value as there are high switching costs present between the two options. There are significant transactions costs in terms of loan establishment fees. Furthermore, a home can serve the bifunctional purpose of an investment- and a consumption good, as previously stated in section 4.1. The latter, reflecting the imputed financial hedge that homeowners create against increasing rental prices (André *et. al*, 2010). Several additional implications are present and will accordingly be highlighted throughout the empirical P/I ratio analysis of the three Scandinavian housing markets.

6.2.2 Scandinavian rental markets

Testing for equilibrium between the user cost and the net income of homeownership can prove a simplistic yet effective method to assess whether house prices are fairly valued. However, the rental market in the three Scandinavian capitals are exposed to various forms of regulation and rent control.

Denmark in particular, and thus Copenhagen, is subject to a high degree of regulation making the rental market extremely inefficient. For instance, if a property has been occupied prior to 1991, there is a cap on the amount of rent the owner is permitted to charge the tenant. According to the Financial Management[1] of the Municipality of Copenhagen (2018), it is only approximately 20% of the private dwellings intended for rent that has a market determined rent cost. Further regulation is imposed by the Housing Control Law from

[1] I.e. 'Økonomiforvaltningen'

1980. The law stipulates a requirement of owner-occupied residence in the majority of dwellings prohibiting investors to invest in some of the housing stock in Copenhagen. The more recent property development areas are usually more lenient in terms of the residence requirement. In January 2017, there were 2,700 dwellings without a residence requirement corresponding to under 1% of the housing stock in Copenhagen (Municipality of Copenhagen, 2018). However, new property project developments are subject to additional rules. For all new housing in city development zones, The Planning Act of June 2016 stipulates that 25% of the total housing areas have to be characterized as general housing. There are 15 general housing associations in Copenhagen managing the general housing stock from a non-profit approach that comprises just under 20% of the total housing stock in the municipality of Copenhagen[2] (Municipality of Copenhagen, 2018).

In Stockholm approximately 40% of the total stock are rental dwellings and according to the Rent Control Index in the EU27[3], Sweden had the highest degree of rent control in 2016 (Gaál, 2017). In Stockholm, the financial imbalance in the user cost between owning or renting an occupation is emphasised by 20-year long waiting lists for some rental homes (BBC Capital, 2016). According to Gaál (2017) this vigorous demand creates a lock-in effect as occupants of rent-controlled dwellings will be reluctant to move and renounce their favourable conditions for renting.

In Oslo, rent control was lifted on private dwellings back in 1982. An empirical study of the development of market rents in Oslo between 1970 to 1982 and after rent control was removed between 1982 to 2011, find that the deregulation did not result in a long-term impact on private rents (Oust, 2018).

Lastly, the rental market for houses is relatively limited in all three capitals, further discouraging the relevance of a price-to-rent ratio analysis.

6.2.3 The link between Price-to-Rent and Price-to-Income ratio

Instead, the thesis will argue that it will provide a better analytical value if price-to-income (P/I) ratios are analysed. Moreover, a higher degree of comparability is obtained when comparing the P/I ratio as opposed to the P/R ratio, between the three Scandinavian capitals. While the P/R ratio measures the relative cost between renting and owning house, the P/I ratio measures local housing costs against the local ability to pay for a house (Himmelberg *et al*., 2005).

The theory and methodology described in the previous section argued the analytical validity and value of using P/R ratios, in order to examine if housing prices are overheated or can be explained by underlying

[2] Housing stock app. distribution in terms of ownership: owner-occupied dwellings 20%, cooperative housing (32%), private rentals (27%), general housing (20%) public (1%)

[3] The abbreviation refers to the 27 member states of EU between 2007-2013

fundamental factors. A resembling logic can be applied when substituting rental cost with a household's ability to pay for owner-occupied housing.

Within the P/R ratio framework disequilibrium is caused by the financial imbalance between the cost of owning and the rental cost. Although, there is no formal equilibrium condition embedded in the P/I relationship, the ratio will imply a bubble formation if it significantly exceeds its own long-term trend (Ibid.). By substituting the annual rental cost in the denominator of equation (6.2.1) with the average household's disposable income, this will result in the following equation for the actual P/I ratio (Dam *et al.*, 2011a):

$$\frac{P}{I} = \frac{House\ price}{Disposable\ income} \tag{6.2.4}$$

Equation (6.2.4) is similar to the P/I ratio adopted in the analysis of house price bubbles in the United States as conducted by Case & Shiller (2004). The rationale behind this measure is the positive relationship between disposable income and house prices. An increase in disposable income qualifies potential homeowners to expenditure a larger amount on accommodation via a wealth effect, as we accordingly outlined disposable income's influence on demand in section 4. Seemingly, disposable income is a key fundamental driver of house prices and is embedded in the majority of house price models, including the model described in section 4 of this paper.

A study, examining real house prices of 14 OECD countries from 2008 (Miles & Pillonca), estimated that 35-45% of the increase in real house prices can be traced back to real income growth. Disposable income as an underlying fundamental factor for house prices will be elaborated further in the comparative fundamental analysis.

An increasing P/I ratio can in some cases be a warning sign to market observers, as house prices do not seem to be supported by fundamental factors and thus, indicating speculative bubble tendencies (Case & Shiller 2004; Shiller, 2006). Following the same approach as prescribed for the P/R ratio, the house price to income relationship stated in equation (6.2.4) should be compared to a P/I ratio based on fundamentals, i.e. the user cost of owning, equivalent to equation (6.2.3). This allows the thesis to examine if the user cost of owning a house has developed disproportionally to the actual P/I ratio, hereby to some extent indicating bubble tendencies.

If a housing market experiences surging prices that cause the two ratios to differ significantly, it could possibly indicate that prices, inter alia, are driven by irrational consumer expectations. The actual P/I ratio is rooted in market conditions, i.e. incorporating all aspects affecting the housing market, including the

speculative element of future price expectations. The fundamental P/I ratio does not account for expectations and a strong deviation between the two ratios that is sustained over time and could indicate a brewing bubble rooted in irrational positive price expectations (Bergman *et al.*, 2013).

The comparison between the actual ratio and the ratio based on fundamental factors is crucial when assessing the state of the housing market. Focusing solely on the development of house prices to the level of disposable income could lead to misleading conclusions (Himmelberg *et al.*, 2005).

If notable breaks in the P/I series are identified these should be considered alongside any regime switching process. Research on the historical development and the sustainability of house prices in Denmark have determined the impact of switching regime processes on the housing market. (Dam et al., 2011b). In this regard the term switching regimes covers changes in government's regulation on structural financial areas that affect house prices. Relevant changes could include deregulation and financial innovation within the mortgage market, changing rental market regulations, revamped approach to property taxation or land-planning restrictions (André *et al.*, 2014).

The thesis will provide a fitting example; a decreasing P/I ratio, i.e. increasing household disposable incomes compared to house prices, could be as a result of deregulation giving households easier access to credit. Firstly, higher disposable incomes will increase demand, put more pressure on the market and cause rising prices. Secondly, easier access to credit will, ceteris paribus, translate into higher levels of household debt making the housing market more vulnerable to unfavourable changes in other fundamental economic factors such as the unemployment rate and interest rate. Conversely, a higher P/I ratio does not necessarily mean that house prices can be described as overheated. Nor will it in all instances entail that house price development has outpaced the growth in disposable income. Similar to the methodology behind the P/R-approach the development in the relationship between house prices and disposable income has to be viewed in the light of the user cost of owning, derived from fundamental economic factors.

Considering the above, it is important to note that fundamentals also can be at an unsustainable level, reflecting unusual and unpredictable circumstances (Muellbauer, 2012). The historically low short and long interest rates on bonds in Denmark, that determines the interest rate on mortgage loans could arguably serve as an example (see appendix 1 for a historical development of interest rates on bonds). If we assume this level is in fact unsustainable, the fundamental will misguide the analysis to indicate that house prices are explained (André *et al.*, 2014). In the empirical P/I analysis, the thesis will be mindful not to be misled and accordingly investigate the sustainability of key economic factors in the paper's comparative fundamental analysis (section 7).

Lastly, research on the development of the user cost in Denmark and Sweden argue that the fundamental P/I ratio is stationary in the long run (Bergman *et al.*, 2013). However, by acknowledging that fundamental

economic factors can also reflect unsustainable values, it implicates the forecast ability of house price relationship ratios as P/I. Fittingly, research on other international housing markets suggests that these ratios are in fact nonstationary[4] (André *et al*., 2014). As a result, the thesis will refrain from forecasting fundamental values and predict the future state of the housing markets in the three Scandinavian capitals.

6.3 Empirical P/I ratio analysis

For each of the three Scandinavian capitals, the following section will examine and discuss, first, the development in the underlying factors of the actual P/I ratio, and then, the development in the actual P/I ratio itself. A short summary with part conclusions is then presented.

Hereafter the analysis will examine the possible deviations between the actual and fundamental ratios, that would indicate a disequilibrium of house prices. The comparison will provide the thesis with a stronger foundation for identifying previous bubble tendencies in the three Scandinavian house markets, as well as give an indication of the current state of these.

Throughout the empirical analysis limitations of the model are highlighted and the implications of the data applied in the analysis is critiqued as well.

6.3.1 Presentation of data material

The analysis includes economic factors that rely on national figures as well as local data, wherever possible and when the added complexity is expected to have a significant impact to the results of the analysis

Owing to differing availability of data critical to the analysis, the actual and fundamental P/I ratios of the three Scandinavian capitals will be examined in different time periods. The analysis of the actual P/I ratio in Copenhagen will include data starting from 1992Q1 to 2018Q2. However, due to the limited access to relevant figures and discontinuation of data series as described in section *Housing taxation - Copenhagen,* the fundamental P/I ratios for Copenhagen will be calculated for the period 2004-2018Q2.

For Stockholm and Oslo, the actual and fundamental P/I ratios is calculated between 1996Q1-2017Q4.

[4] I.e. data is unable to be modelled or forecasted due to changes in variances and covariances over time.

6.3.2 Data used to calculate the actual price-to-income ratio

House price (P)

To remain consistent, average price per m2 is included as the measure of housing prices in the empirical P/I analysis. However, nominal house prices are included rather than real prices in order to highlight the impact of inflation. This is necessary as the inflation rate serves as the measure for expected capital gain.
The thesis will refer to section 2 for a more detailed description of the applied house prices.

Income (I)

Household disposable income is obtained through OECD statistics and is published annually in USD per capita. The indicator is stated in current prices (i.e. nominal values) and purchasing power parities. The number reflects households' total consumption expenditure and savings. The sum is primarily given by salaries, net property income, net current transfers and social benefits, minus taxes on income and wealth, and social security contributions from employers. However, the indicator is gross adjusted so that government social transfers within e.g. health and education are reallocated as additional household income (OECD Data, 2018).

Unfortunately, the household income indicator provided by OECD is only given on an annual basis. Applying a yearly measure of income to an analysis that includes quarterly house prices will lead to a crude illustration of the P/I curve. To resolve this, household disposable incomes are projected based on the national quarterly development in GDP, given by OECD.Stat (2018). The approach is inspired by an analysis conducted by Nissen *et al.* (2013). In practice, incomes are multiplied by the corresponding quarterly GDP growth rate[5] to project the household income in the second, third and fourth quarter of each relevant year.

The empirical analysis' based on P/I ratios are delimited to a specific geographic area, however in all three cases the national average for disposable income per capita is included due to limited data availability. Arguably, it would improve precision of the housing affordability calculation to include income data from a defined geographic area and age groups as home buyers and sellers tend to be overrepresented in certain age groups with higher incomes than the population mean (Girouard *et al.*, 2006). For instance, in Denmark only 3% of the population over fifty years of age move to another dwelling within a year. In comparison, 20% of people in their twenties will move within a year (Politiken, 2018a).

Additionally, individuals living in metropolitan cities such as the three Scandinavian capitals will need a higher income, compared to national averages, in order to serve the relatively higher housing cost. However,

[5] GDP growth rate compared to the previous quarter and seasonally adjusted – OECD, National Accounts, Measure: GPSA

the imprecision is somewhat offset by the fact that every inhabitant in each country could, in theory, choose to enter the housing market in the respective capital. Thus, the demand from habitants of surrounding cities of Copenhagen, Stockholm and Oslo are likely to have an impact on house prices within the capital.

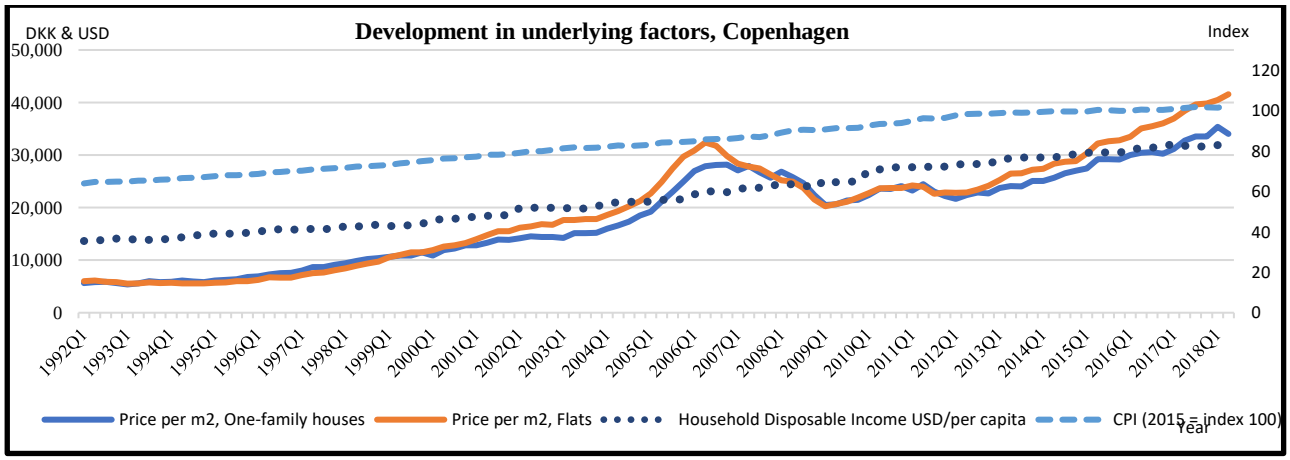
For above stated reasons and general comparability purposes, national average income values are used in all three cases.

6.3.3 Copenhagen

6.3.3.1 Development in the underlying factors of the actual P/I ratio

The historical development of some of the underlying factors included in equation 6.2.3 and 6.2.4 is examined. Namely, the price per m^2 for owner-occupied flats and one-family houses in Copenhagen, the nominal disposable household income and the CPI for Denmark as a whole, are examined and illustrated in figure 0-9. Household income and house prices are given in USD per capita and DKK respectively and are plotted against the left y-axis. The CPI index is plotted against the right y-axis due to scale. The calculations for the figures shown in section 6.3.3 are illustrated in Appendix 6.6.

Figure 0-9 - The development in the underlying factors of the actual P/I ratio for Copenhagen



Sources: Finance Denmark, OECD Data & OECD iLibrary – see appendix 6.6 that includes data for the actual P/I ratio for Copenhagen

In section 5, the thesis remarked on the historical development of housing prices in Copenhagen. This section will examine the price development in relation to the trend in disposable income and CPI. The latter factor is included in this paragraph as the model framework assumes house prices will increase with the inflation rate. As a result, the analysis will separate and compare the growth in nominal house prices and the inflation rate. The CPI plot is illustrated with 2015 as the baseline year (i.e. index 100) and shows a steady increasing trend in the examined period of time, from index 64,0 in 1992Q1 to 102,3 in 2018Q2. The pace of growth seems to recede between 2011Q2 (96,2) and 2015Q1 (99,6). The slowdown becomes evident when observing the quarterly growth rate in CPI, included in appendix 6.6.

From 2012, the quarterly increase in CPI has been below 1% and the growth rate has been below 1,5% in the entire examined time period. This is in line with the monetary policy of Nationalbanken which is aiming to keep annual inflation below but close to 2% in the medium term (Spange & Toftdahl, 2014). Theoretically, in the long-term Denmark's inflation rate would be expected to follow the overall development of inflation within the EU area due to the fixed exchange rate policy between the euro and the Danish kroner. However, recent observations following the illustrated period in figure 0-9, reveal that the Danish inflation rate is the absolute lowest within EU between August and October 2018 (DST, 2018a). A significant spike in 2008Q3 is evident from the graph above where CPI grew with 4,18%, the highest growth rate in the relevant time period, and arguably a reaction to the global financial crisis and the Danish housing bubble. Interestingly, in Porteba's model, the spiked inflation rate would materialize in a higher expected capital gain and therefore a lower user cost of owning a house. A lower user cost would, ceteris paribus, theoretically advocate to the point that increasing house prices could be sustained. On the contrary and as figure 0-9 illustrates the average house prices in Copenhagen were still plummeting from their peak levels in 2006-2007 to their post-crisis low point in 2009Q1, where nominal prices dropped to DKK 20.483 and 20.284 per m^2 for one-family houses and flats respectively. This underlines the importance of looking at the underlying economic factors of the P/I framework before drawing any conclusions from the deviations between the actual and fundamental ratio.

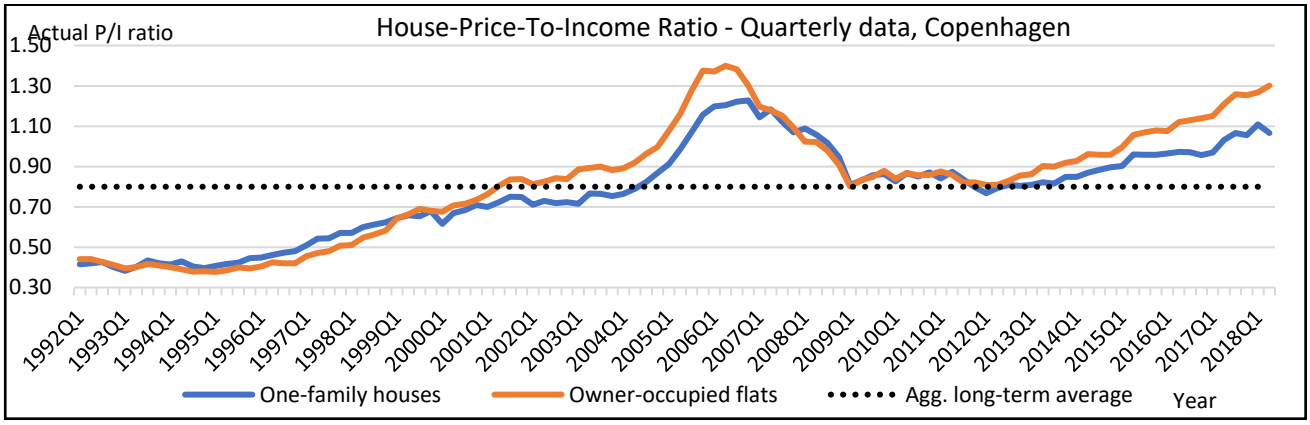
The development in the disposable income can be described to follow a steady positive trend. What stands out is the lack of response in the income measure to the aggressively increasing house prices leading up to the crash. One should expect household disposable income to experience a more noticeable bump while house prices were surging due to the fact that disposable income accounts for capital gains from homeownership. (i.e. net property income).

Overall, house prices have increased far more rapidly compared to both the increase in inflation and in disposable income. Since 1992, the average price per m^2 have increased more than 500% for both types of dwellings, comparatively CPI and disposable income have grown with 60% and 134%.

6.3.3.2 The development of the actual P/I ratio

Equation 6.2.4 express the relationship for the actual P/I ratio. Figure 0-10 illustrates the development of the actual P/I ratio for one-family houses and owner-occupied flats in Copenhagen between 1992Q1 and 2018Q2. The ratios are measured in nominal terms and plotted against their joint long-term average value equal to 0,80.

Figure 0-10 - The development of the actual P/I ratio for Copenhagen



Sources: Finance Denmark, OECD Data and own calculations – see appendix 6.6 for further information

Figure 0-10 shows how the current P/I ratio for flats and one-family houses in Copenhagen both deviate from the aggregated long-term average value of 0,80. The P/I ratios in 2018Q2 is equal to 1,07 and 1,30, respectively for flats and one-family houses. Although a formal definition of equilibrium is absent in the theoretical framework, the model emphasises how both housing markets have become less affordable for households. The theory states that the P/I ratio should be close to equal to its long-term average value as a general indication of the market being in a close to an equilibrium state (André *et al.*, 2014).

Historically there is evidence pointing towards the P/I ratios generally reverting to their long-term average over a longer period of time (André, 2010). However, from the graph we see that both P/I ratios were relatively close to their aggregated long-term average value of 0,80 in 2009 to 2013. Interpreting the ratios at their face value, this approximation could indicate a status quo in terms of housing affordability in Copenhagen in 2009 to 2013. This protracted period is followed by a positive trend in both P/I ratios clearly exceeding the long-term average value. This could in turn indicate that the market for both types of housing are exemplifying bubble tendencies, i.e. house prices are overvalued.

The latest available data for Copenhagen is interestingly quite ambiguous. On the one hand, the P/I ratio for one-family houses have decreases from 1,11 to 1,07 between the first and second quarter of 2018. Simultaneously, the positive trend is continued for the P/I ratio for flats starting from mid-2012 to the latest observation. In 2018Q2 the ratio is equal to 1,30 making it worryingly close to the peak level of 1,40 in mid-

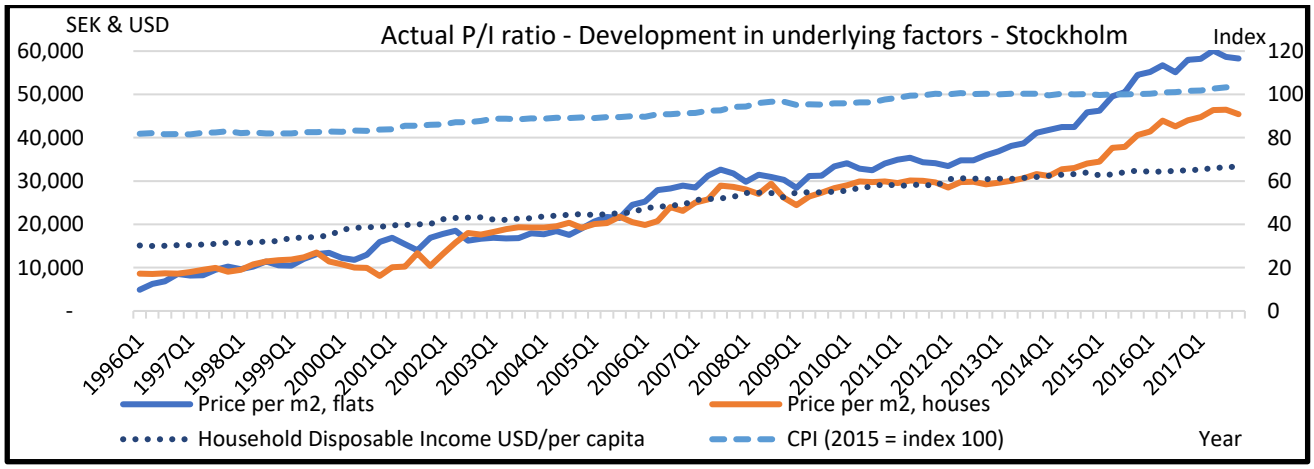
2006, prior to the housing market crash in Copenhagen and Denmark. Moreover, it is relevant to note that the latest data point represents the largest gap between the two ratios in the examined timeframe. The present gap could be an indication of other factors unequally affecting the demand of the two types of housing.

6.3.4 Stockholm

6.3.4.1 Development in underlying factors of the actual P/I ratio

The historical development of the price per m2 for owner-occupied flats and houses in Stockholm, disposable household income and the CPI for Sweden as whole, are all illustrated in figure 0-11. Income and house prices, stated in USD per capita and SEK respectively, are plotted against the left y-axis and CPI on the right axis. The calculations for the figures shown in section 6.3.4 are illustrated in Appendix 6.7.

Figure 0-11 - The development in the underlying factors of the actual P/I ratio for Stockholm



Sources: Alfred Berg Asset Management, OECD Data & OECD iLibrary – see appendix 6.7 that includes data for the actual P/I ratio for Stockholm

The graph above illustrates a general positive trend in all factors. As mentioned earlier, in the historical development of the housing market in Stockholm, housing prices did not respond as severely to the global financial crisis compared the prices in Copenhagen. The price development was relatively more stable in the period leading up to pre-crisis peak in 2007Q3 as well as in the aftermath of the crisis. House prices recovered almost at a remarkable rate and as the graphs illustrate recent house prices in Stockholm far exceeds any pre-crisis level. Growth in CPI and in disposable income have been more elusive and far from matching the growth in nominal price for flats and houses, equalling 775% and 429% in the examined period. Interestingly, the growth in CPI in Sweden has been noticeably lower compared to Denmark, experiencing an overall increase of 27%.

Focusing on the development in the inflation rate leading up to the financial crisis, the CPI increased sharply from 2006 to 2008Q3. Afterwards the development was more stable and inflation was close to constant between 2012 and 2016, representing a prolonged and unusual low level of inflation. According to research conducted by the Riksbank, the entity responsible for the monetary policy in Sweden, the low inflation was

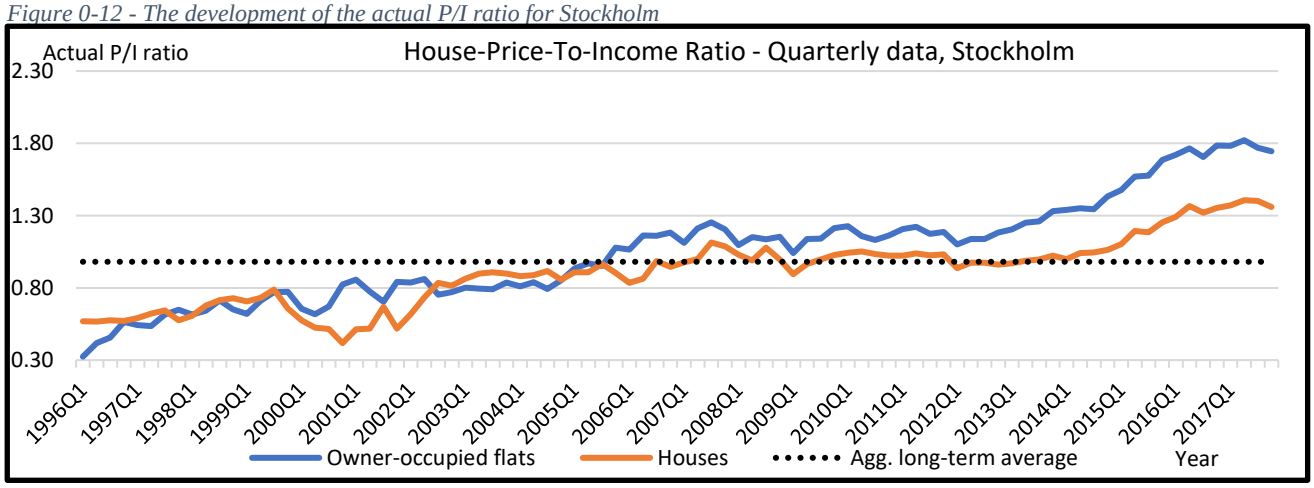
primarily the result of a weak development in international economies that affected demand and the exchange rate negatively (Andersson *et al.*, 2015). The Riksbank attempted to revive inflation growth by cutting the repo rate to negative levels, which directly affects CPI, and bought government bonds in an attempt to stimulate demand in the market. The monetary policies and measure undertaken by the Riksbank will be elaborated in the upcoming comparative fundamental analysis, in the section examining the *Key Policy Rate*. Seemingly the measures undertaken by the Riksbank has, inter alia, galvanised growth in CPI. Since 2016, inflation grew from index 100,3 to 103,5 in 2017Q4.

The growth in household disposable income have experienced a similar development, again compared to Denmark, with an overall increase of 124% between 1996 and 2017. Although on average, Swedish households have a larger disposable income in nominal terms, exceeding the Danish average with just over USD 500 in 2017. Furthermore, the curve in the development of disposable income is less steep compared to the growth in housing prices. The above graph illustrates how the development in disposable income and house prices has somewhat followed each other, but from 2012 price growth for flats in Stockholm has significantly outpaced the increase in income. From 2015, the increase in house prices has similarly grown more rapidly than income, calling for further investigation.

6.3.4.2 The development of the actual P/I ratio

Figure 0-12 illustrates the development of the actual P/I ratio for houses and owner-occupied flats in Stockholm between 1996Q1 and 2017Q4. The ratios are measured in nominal terms and plotted against their joint long-term average value equal to 0,98.

Figure 0-12 - The development of the actual P/I ratio for Stockholm



Sources: Alfred Berg Asset Management, OECD Data, OECD iLibrary and own calculations – see appendix 6.7

As expected from the analysis of underlying factors, the above P/I ratios show an overall increasing trend. For both types of dwellings, the graph illustrates an accelerated increase in the actual P/I ratios starting from 2012 for flats and 2014 for houses, leading up their shared peak in 2017Q2. From looking at the development in the household disposable income, it is evident that the increasing ratios are rooted in house prices increasing more rapidly than income, hence reflecting the decreased affordability of housing in Stockholm. According to the model, the development of the actual P/I ratio for flats indicates a slight overvaluation of flat prices between 2006 and 2012, as the ratio moderately deviates from the aggregated long-term trend in this period. From here, the ratio experiences a steep increase moving further away from the long-term ratio value and therefore indicating bubble tendencies.

The development of the actual P/I ratio for houses in Stockholm indicates that prices between 2005 and 2015 have been at a fair level, as it fluctuates closely to the long-term average ratio value. The flat development of the ratio in this prolonged period, supports that the affordability of houses in Stockholm have been relatively stable as house prices and disposable income have grown almost proportionally. Although in more recent years, and since 2013Q2, the actual P/I ratio for houses has significantly deviated from the long-term average value, again indicating bubble tendencies.

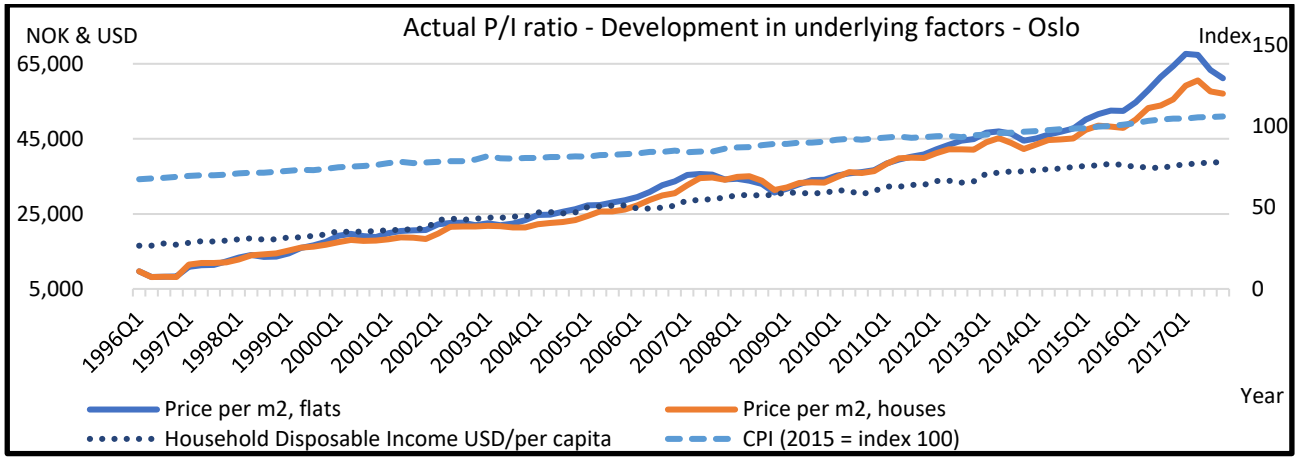
Akin to the recent development of actual P/I ratios in Copenhagen, a trend is persistent in the increasing gap between the ratios of the two types of dwelling. The possible reason for this distorting development calls for further examination of key economic fundamental factors.

6.3.5 Oslo

6.3.5.1 Development in underlying factors of the actual P/I ratio

The historical development of price per m^2 for owner-occupied flats and houses in Oslo, disposable household income and the CPI for Norway, are all illustrated in figure 0-13. Income and house prices are plotted against the left y-axis and CPI on the right. The calculations for the figures shown in section 6.3.5 are illustrated in Appendix 6.8.

Figure 0-13 - The development in the underlying factors of the actual P/I ratio for Oslo



Sources: Alfred Berg Asset Management, OECD Data & OECD iLibrary – see appendix 6.8 that includes data for the actual P/I ratio for Oslo

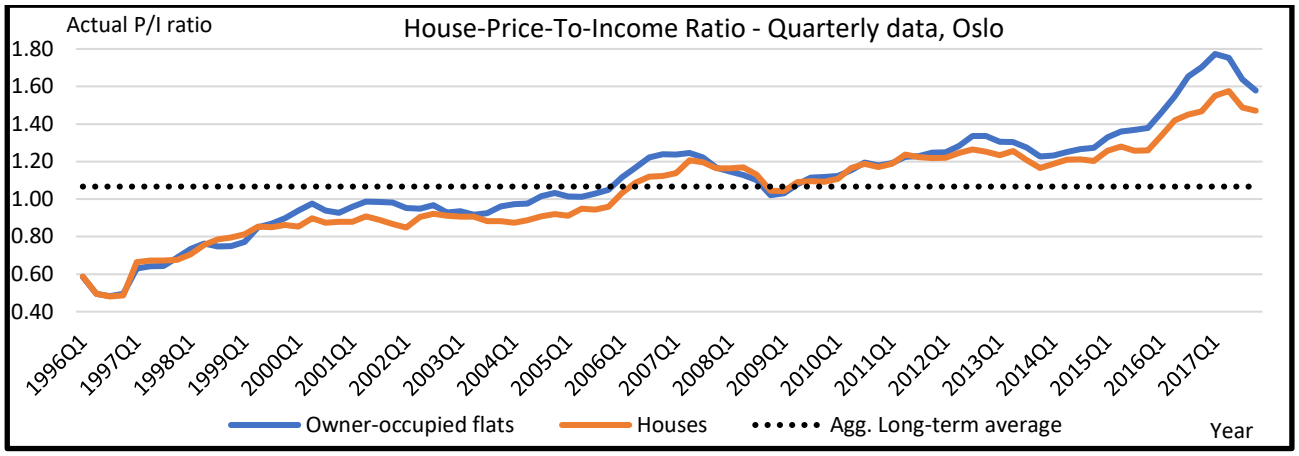
The graph above indicates a similar development compared to the two other Scandinavian capitals. Over the examined period, house prices have experienced more rapid growth compared to other prices. Specifically, the average nominal price for flats in Oslo have increased with 531% between 1996 and 2017, and houses have increased 486% in the same period. CPI has experienced an overall increase of 57% in Norway, indicating a similar overall development to Denmark with the exemption of the most recent observations. As mentioned earlier, inflation in Denmark has recently fallen to very low levels while Norway has experienced a positive trend in CPI since 2011. Furthermore, inflation has picked up from 2015 which amongst other things can be attributed to increasing investment in petroleum, an industry Norway as a nation is greatly dependent on. This has boosted the Norwegian economy and prompted Norges Bank to reduce their target inflation from 2,5% down to 2% (SSB 2018b).

Norwegian households have witnessed an overall increase of 134% in disposable income, surpassing the growth experienced in Sweden. Furthermore, Norwegians have the highest income by far of the three Scandinavian countries, with a household disposable income of USD 38.771 per capita in 2017Q4 in nominal terms. After the financial crisis, growth in housing prices is quickly reintroduced and from figure 0-13, it is evident that the rate of increase seems to accelerate from 2009. Growth in disposable income has failed to keep up with the intensified increase in housing prices in this period, reflecting a decreased affordability.

6.3.5.2 The development of the actual P/I ratio

Figure 0-14 illustrates the development of the actual P/I ratio for houses and owner-occupied flats in Oslo between 1996Q1 and 2017Q4. The ratios are measured in nominal terms and plotted against their long-term average value of 1,07.

Figure 0-14 - The development of the actual P/I ratio for Oslo



Sources: Alfred Berg Asset Management, OECD Data, OECD iLibrary and own calculations – see appendix 6.8

The above graph illustrates a positive trend in the actual P/I ratio for both types of housing in Oslo. As noted in the previous discussion of underlying factors, this development reflects that the affordability of housing in Oslo have worsened since 1996. In the examined period, the ratio for flats lie in the interval 0,48 and 1,77, whereas the ratio for houses fall between 0,48 and 1,58. The development of the actual P/I ratios indicate bubble tendencies compared to their long-term average value between 2006 and up the last quarter of 2008. This coincides with the global financial crisis that caused real economic losses globally and impacted homeowners negatively through increasing interest rates. Norway was no exception as the stock market crashed realising a 64% price drop between May and November in 2008. However, the Norwegian economy and housing market was quick to recover, compared to Danish market especially, owing to a substantial and stable revenue stream from the petroleum industry and a less exposed financial sector in general (Grytten & Hunnes, 2014). The actual P/I ratios for the housing market in Oslo supports this assertion in terms of housing prices recovering quickly post-crisis. From 2009Q2 and onwards, both ratios continue to increasingly surpass their joint long-term average, before taking a downturn in recent observations from 2017. Once again, the actual P/I ratio for flats increasingly exceeds the one for houses supporting the trend that was also identified in the other two Scandinavian capitals.

6.3.6 Summary, part conclusion

The analysis of handpicked economic factors that are key to the development of the actual and fundamental P/I ratio, all reveal that nominal house prices in the capitals has outpaced the increase of other prices.

The gap between the overall increase in examined prices would probably narrow if local income data was applied. Earlier the paper has described how increases in house prices has been salient in the three capitals compared to the overall development in each nation. According to Gyourko *et al.* (2004) attractive metropoles that experience relatively higher demand than smaller less attractive cities in the its vicinity, will

attract high income households. Given this relationship, it is important to keep in mind that some home buyers of dwellings in the capital will probably have a higher disposable income compared to the national average income of households. Hence, including local income measures in the actual P/I ratio would most likely indicate improved affordability conditions in the paper's analysis.

For all three Scandinavian capitals, the development in the actual P/I ratio indicates current bubble tendencies as they deviate and are well above their respective long-term average value.

In the last quarter of 2017, the actual P/I ratio for flats and houses in Stockholm was 1,75 and 1,36. For Oslo, the actual P/I ratios are 1,58 and 1,47 respectively. In the same period, the P/I ratios for Copenhagen was equal to 1,25 and 1,06 for flats and one-family houses. Respectively, the actual P/I ratios long-term average values for each capital was calculated as 0,98, 1,07 and 0,80. The ratios indicate the relative proportion of house prices to household's disposable income. However, it is meaningless to draw conclusions by directly comparing actual ratios between cities and even more so between nations, as regional and national differences impact the general level of the ratios. Following the argumentation put forward by Himmelberg *et al.* (2005), the above analysis of the actual P/I ratios is not sufficient to justify the presence of a bubble on a stand-alone basis. The analysis has to be supported by an analysis of the development in fundamentals, in order to examine if the house price growth in fact is supported by underlying factors.

6.4 The development of the fundamental P/I ratio

This section will analyse the historical development in selected economic factors, in order to provide a further insight on how the affordability of housing has evolved in the examined period.

According to the theory, the housing market is overvalued when the actual P/I ratio exceeds the fundamental one. The analysis of the actual P/I ratio applies an average price per m^2 in local currency (DKK, SEK and NOK) and the income measure is given in USD. As a result, the actual and fundamental P/I ratio will not be comparable to scale. To resolve this issue the two ratios are recalculated as an index, using 2017 as the base year for the indexation. To avoid a seasonality component, index 100 is set to equal the average house price in 2017. Arguably, this does not problematize the analytical value of the comparison between the two ratios as it is the relational development that is interesting to examine. The argument is supported by referencing the empirical evidence of P/I ratios calculated for cities in the United States (Himmelberg *et al.*, 2005). The analysis concludes that a given ratio for one city might be significantly higher or lower compared to another, without any indication of bubble tendencies in either cases. This supports the analytical choice of comparing the fundamental and actual ratios based on an index rather than actual values. Furthermore, this will allow more precise interpretation when assessing the inter-development between the three Scandinavian capitals.

An increasing fundamental P/I ratio indicates that higher house prices can be justified by economic factors and vice versa. In other words, it is the difference between the two measures that in fact will indicate if houses prices are either over- or undervalued. If the actual P/I ratio is higher than the fundamental one it is an indication that house prices are overvalued and vice versa.

6.4.1 Data used to calculate the fundamental price-to-income ratio

Girouard *et al.* (2006) have conducted a thorough international case study of the housing markets in 18 OECD countries, from 1970 to 2005. The researchers present a guideline on how a P/I analysis could be structured when the purpose is to draw inter-country comparisons. Finding the right degree of complexity while maintaining comparability can prove a challenging task. As a result, the P/I analysis will follow the methodology and include close to similar assumptions as stated in the authors paper; *"Recent House Prices: The Role of Fundamentals"* (2006).

The data described below is included either explicitly or implicitly in the appendices X,X and X for the fundamental P/I ratios. As per the OECD study, we will assume the following in our calculations of the fundamental P/I ratio:

Nominal mortgage interest rate (i)

National average values are applied for each country.

In the case of Denmark, data is obtained through Finance Denmark (2018a) based on the weekly average long mortgage bond interest rate. The weekly interest rate is recalculated into quarterly figures by a simple average.

For Sweden, the nominal mortgage interest rate is given as the average interest rate on mortgage bonds with five years to maturity. The market-based interest rates are provided by The Riksbank (2018a) in Sweden.

For Norway, historical data on the average nominal interest rate on loans is provided by SSB (2013) from 1996 to 2012. From 2013 and onwards, the average interest rate on outstanding repayment loans with a maturity over five years and secured on dwellings is applied (SSB, 2018b). The interest rates are recalculated from monthly into quarterly.

Nominal mortgage interest rate after-tax (i_a)

The personal income tax system in all of the three Scandinavian countries have the common trait of allowing mortgage interest payments to be treated as a tax deductible. This represents an offsetting benefit reducing the cost the homeowner will incur in terms of his or her forgone interest from alternative investments

(Girouard *et al.*, 2006). Thus, the nominal mortgage interest rate after tax is relevant to apply in the analysis. As a result, the relevant tax rate that interest expenses are levied against is applied to match the actual taxation of each country. However, the analysis does not account for deduction ceiling brackets or credits.

In the case of Denmark, the interest on mortgage debt has been deductible since 2002 at a 33,6% rate. Following a tax reform from 2010, interest payments exceeding DKK 50.000 (for an individual) would be subject to a lower deductibility rate from 2012, that is progressively reduced towards reaching a planned deductibility rate of 25,6% in 2019 (IMF, 2014). The thesis will assume that the interest deductibility in the fundamental P/I analysis for Copenhagen is equal to 33,6% throughout the entire period. The increased complexity from incorporating reductions and take deductions ceilings into account would not correspond to the additional analytical value it would bring. Furthermore, a recent empirical study of the impact of reductions in deductibility of mortgage interest payments have shown they have had zero effect on homeownership, even in the very long run (Gruber *et al.*, 2007)

For Sweden, a flat income tax rate of 30% is applied throughout the examined period of time. See section X in housing taxation for a detailed explanation.

In Norway, interest income is treated as any other form of capital income which is taxed at a general income tax rate equal to 24% in 2017. NTA (2018c) keeps an overview of the tax rate for general income, which in recent years have been reduced several times. The fundamental P/I ratio for Oslo will account for these reductions in the interest deductibility rate.

Property tax (π_t) and Land tax (π_l)

The effective property tax rates are calculated and explained in detail in the section *Housing Taxation*, which is included in the *Comparative Fundamental Analysis* section of the paper. A brief overview of property taxes included in the fundamental P/I ratio for each capital, is presented below.

In Denmark, property taxes consist of two separate taxes, property value tax and land tax. A joint effective property value tax rate is applied to both types of housing, whereas an individual effective land tax rate is applied for one-family houses and flats. Therefore, the analysis will incorporate a fundamental P/I ratio for flats and a ratio for one-family houses in Copenhagen.

Land tax rates varies between Municipalities and this is accordingly considered in the analysis as the paper adopts a regional effective land tax rate for Copenhagen. The subject is further complicated by the inaccessible register data for the official public valuations conducted prior to 2004. As a result, the analysis of Copenhagen is delimited to the period of 2004 to 2018Q2.

Since 2001, the formal property tax rate in Sweden has not been uniform for houses and flats. Therefore, a separate effective property tax rate is applied throughout the analysis which in turn provides the analysis with a specific fundamental P/I ratio for flats and for houses in Stockholm. There is no land tax imposed on owner-occupied properties in Stockholm, or Sweden for that matter.

Prior to 2016, there was no property tax rate imposed on owner-occupied dwellings in Oslo and there is no land tax imposed on owner-occupied properties in Norway. In 2016 a formal property tax rate was introduced in Oslo, but the tax is effectively imposed on a very limited number of homeowners. As a result, a single fundamental P/I ratio reflecting the user cost for both types of housing is calculated.

In section 7.6 a detailed description of approach and the various data sources that comprise the effective property tax rates is given.

Recurring holding costs (f)

The recurring holding cost is an aggregated measure reflecting depreciation and maintenance, as well as the risk premium from owning versus renting. The holding cost is assumed to equal 4% as a constant each year (Girouard *et al.*, 2006).

Expected capital gain (π)

In line with the model assumptions for the user cost of owning, the expected capital gain distributed to homeowners is assumed to equal the overall inflation rate. Empirically, expectations about future capital gains or losses, to some extent are determined by past developments and therefore tend to be backward looking (Cho, 1996). Maintaining the original model, created by Poterba (1992), expected capital gain will equal a five-year moving average of the inflation rate.

It was earlier explained how the development in consumer prices can serve as an indication of the overall inflation rate. In the empirical analysis, the respective consumer price index (CPI) will reflect the inflation rate in the given country. The CPI's are published by OECD from their database of main economic indicators (OECD iLibrary, 2018). The collection of data is performed on a harmonised approach across countries, making it an appropriate measure for international comparison.

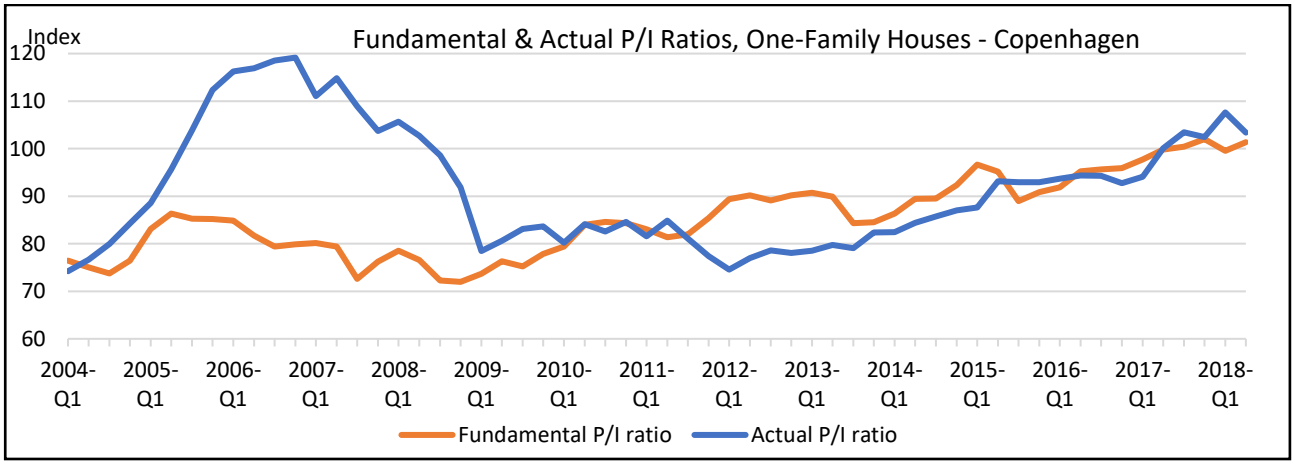
Sweden and Norway, represent a special case in this matter as the realized profit from selling a dwelling will be subject to a capital income tax. However, the tax can be avoided if certain conditions are met and therefore the thesis will not adjust the capital gains in the analysis. See section X for further explanation and formal capital gain tax rates in Sweden and Norway.

6.4.2 Copenhagen

The expression of the fundamental P/I ratio, i.e. user cost of living in an owner-occupied dwelling, is given by equation 6.2.3. Equation 6.2.4 illustrate the relation of the actual P/I ratio.

Figure 0-15, illustrates the historical development of both the actual and fundamental P/I ratio with respect to one-family houses, between 2004 and 2018Q2.

Figure 0-15 - The development of the fundamental P/I ratio and the actual P/I ratio for one-family houses in Copenhagen



Source: Finance Denmark, DST, OECD and own calculations – see appendix 6.9

The graph illustrates several deviations between the two ratios in the examined time period, indicating both under- and overvaluation of house prices. As one would expect, there is a considerable deviation between the ratios during the boom and bust housing market in the 2000's. Specifically, the actual P/I ratio for one-family houses in Copenhagen exceeds the fundamental one starting from 2004Q2 up until 2010Q2, accordingly indicating a strong bubble formation in this period. Furthermore, the development in the actual ratio for one-family houses is more volatile than the fundamental P/I ratio.

During 2005, the fundamental ratio increased along the actual ratio, although from a lower level, but still indicating that the house price growth is possibly supported by changes in economic factors. Based on the thesis' own calculations it is primarily lower mortgage interest rates in combination with a decreasing effective property value tax rate (see *Housing Taxation* for an analysis of the debt-bias taxation of properties in Copenhagen) that drive the increase in the fundamental P/I ratio until 2006, from where a downward turn takes place. Mortgages with deferred amortization was first introduced in Denmark in the autumn of 2003, thus immediately prior to this examined period of time. Although, deferred amortisation does not alter the total user cost of owner-occupied housing for the individual obtaining the loan, it does however alter the repayment profile with the postponement of repayments. Theoretically, the option to defer amortization should not affect house prices. However, analyses of housing markets indicate that such financial innovations have impacted house prices in Denmark and other European countries (Dam *et al.*, 2011b; André, 2010). Amongst other driving forces, the researchers point to the short-sighted nature of individuals

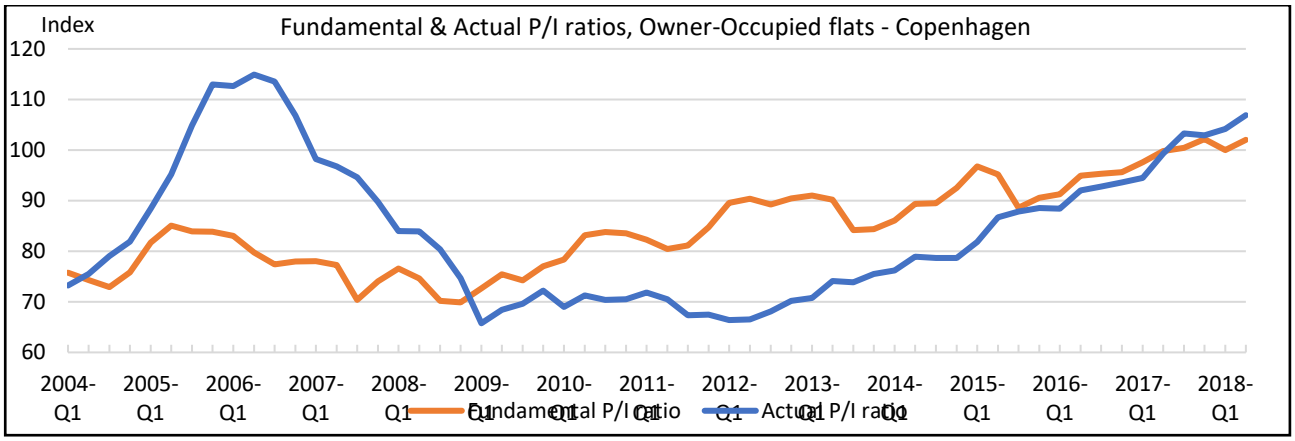
and their tendency to exercise irrational behaviour as an explanation for the significant impact of deferred amortization loans on housing prices. Empirically, individuals tend to focus largely on the first-year payment when contemplating the purchase of a given home (Dam *et al.*, 2011b). With the mortgage innovation and in combination with a wide popularity of adjustable rate loans first-year payments were reduced, increasing individual's willingness to obtain more debt causing a higher pressure on the demand of housing. Furthermore, existing home owners were presented with improved conditions and easier access to credit, as they could benefit from mortgage equity withdrawals. As house prices surged so did the home equity of many homeowners allowing them to refinance their initial loan portfolio to a less costly one by using home equity as collateral (André, 2010). The fundamental P/I ratio for one-family houses accounts to some degree for this development up until 2006. Afterwards, the development of the two ratios moves in opposite direction, strongly indicating bubble tendencies. Positive expectations about future house prices could be complicit to this deviation as these are not considered in the fundamental P/I ratio. Assuming individuals are exemplifying fully rational behaviour, then the demand of housing should be determined alone by the true economic user cost of housing. Of course, this assumption is far from the observed market behaviour of individuals, and as a consequence, deviations between actual and fundamental P/I ratio can, inter alia, be attributed to irrational expectations and presumptions about the current and future state of the housing market.

As the thesis argued in section 3, a defining characteristic of a house price bubble is when there is a widespread and strong belief that prices will continue to increase in the future (Case & Shiller, 2004). Arguably, home buyers were keen to capitalize on rapidly increasing house prices during the boom. From a fear of missing out on the wealth upswing individuals accepted higher price points and bought a costlier house than their personal finances could bear in the long-term, but a strong belief of being compensated by future price increases invoked them to deem it as an acceptable expense (Dam *et al.*, 2011b).

After the housing bubble burst, the actual P/I ratio accordingly declines due to plunging house price and cuts in household disposable income. In the beginning of the downward turning housing market, the development of the fundamental P/I ratio for one-family houses shows an overall positive trend in the remaining period. Post-crisis, the ratios only deviates slightly between 2010Q1 and 2011Q3 which according to the theoretical framework should be interpret as an equilibrium state of the prices for one-family houses in Copenhagen.

However, equilibrium is short-lived and from 2011Q3 to 2015Q3 figure 0-15 illustrate that the user cost of owning a house has increased to a level that deems the corresponding house prices as undervalued. The analysis show that the increasing fundamental P/I ratio is mainly rooted in decreasing interest rates on mortgages that have been reduced from 5,14% in 2011Q2 to 2,12% in 2018Q2. Despite the historically low mortgage interest rates the analysis interestingly indicates a slight overvaluation of one-family house prices in Copenhagen since 2017Q2.

Figure 0-16 - The development of the fundamental P/I ratio and the actual P/I ratio for owner-occupied flats in Copenhagen



Sources: Finance Denmark, DST, OECD.Stat, OECD iLibrary, OECD Data and own calculations – see appendix 6.9

The development of the two P/I ratios with respect to owner-occupied flats in Copenhagen, generally indicates similar tendencies as the ratios for one-family houses. However, there are several differences that are interesting to point out. Specifically, the actual P/I ratio for flats rise and fall more abruptly compared to the actual ratio for one-family houses during the boom and bust period of the Danish housing market. The model's result is supported by the development in actual real housing prices, as the bubble formation of this period was led forward by a rapid price growth in flats that outpaced the growth in one-family house prices in the mid 2000's (cf. chart of development in underlying factors).

It follows that declining house prices does not universally indicate a recent or present bubble in the housing market. A downward turning house market can be the justifiable result of changing underlying fundamentals and in this case the price development is substantiated, thus not reflecting any bubble tendencies (André *et al.*, 2014).

Considering the fact that prices for flats in Copenhagen started to plunge from 2006Q3 and up to a turn in the development in 2009Q1, the development of the two P/I ratios supports the underlying price development for flats as they intercept in 2009. From here the fundamental P/I ratio for flats in Copenhagen commences a positive trend although with small corrections, akin to the development in the fundamental ratio for one-family houses. While the development of the actual and fundamental P/I ratio for one-family houses indicated equilibrium prices in the first years following the financial crisis, the development of the ratios for flats instantly indicates undervaluation from the intercept in 2009Q1. Thus, the increasing real prices of flats in Copenhagen are seemingly supported by the development of economic factors included in the fundamental P/I ratio.

The deviation between the P/I ratios for flats indicates undervaluation from 2009Q1 up to and including 2017Q3. The deviation seems to reach its maximum in 2012, identical to the analysis of one-family houses.

During this period, the actual P/I ratio for flats is increasing steadily, a growth that is more than adequately supported by changes in fundamentals. In this particular case, a decrease in both effective property land- and value tax rates, along with extraordinary low mortgage interest rates and inflation in combination, are causing the analysis to indicate an undervaluation of flat prices. As mentioned earlier in the paper, the latter factor is included in the fundamental P/I ratio as the measure for expected capital gains. Notably, the five-year moving average of the inflation rate has been remarkably low between 2013Q3 and 2017Q1, with 0,20% and even -0,01% as the respective max and minimum observation. In hindsight, the nominal prices for flats in Copenhagen increased 28,4% in the same period. Thus, the incorporation of the inflation rate as the measure for house price increases clearly impose severe implications. However, house price development is notoriously difficult to forecast, as to why some empirical house price models chooses to leave expected capital gains out of the equation (Dam *et al.*, 2011a).

Figure 0-16 illustrates that the actual P/I ratio exceeds the fundamental one from 2017Q3 and onwards, indicating that recent flat prices in Copenhagen are overvalued. Considering the recent debate and the upcoming changes for property taxation in Denmark, this development can seem counterintuitive. In summation, property taxes for flats in Copenhagen are expected to increase significantly with the publication of new official valuations.[6] This information should, inter alia, increase uncertainty about the future real financing cost of living in an owner-occupied flat in Copenhagen. Although, the new tax rates have not officially been determined and will not come into effect before January 2021, the deviation indicates that home-buyers of flats in Copenhagen are not considering the expected negative impact on market values from the new tax reform. According to Las Olsen, Chief Economist at Danske Bank, it is however unfair to assume that individuals can construe the new official valuations and their implications for housing prices. (Berlingske, 2018a). Recent data following the period examined in this analysis, reveal how the real price per m^2 for flats in Copenhagen have started to fall since reaching their historical peak level in May 2018 (Berlingske, 2018b). To what degree the looming new property taxes have influenced this development is difficult to determine and beyond the analytical capability of the nonstationary fundamental P/I ratio.

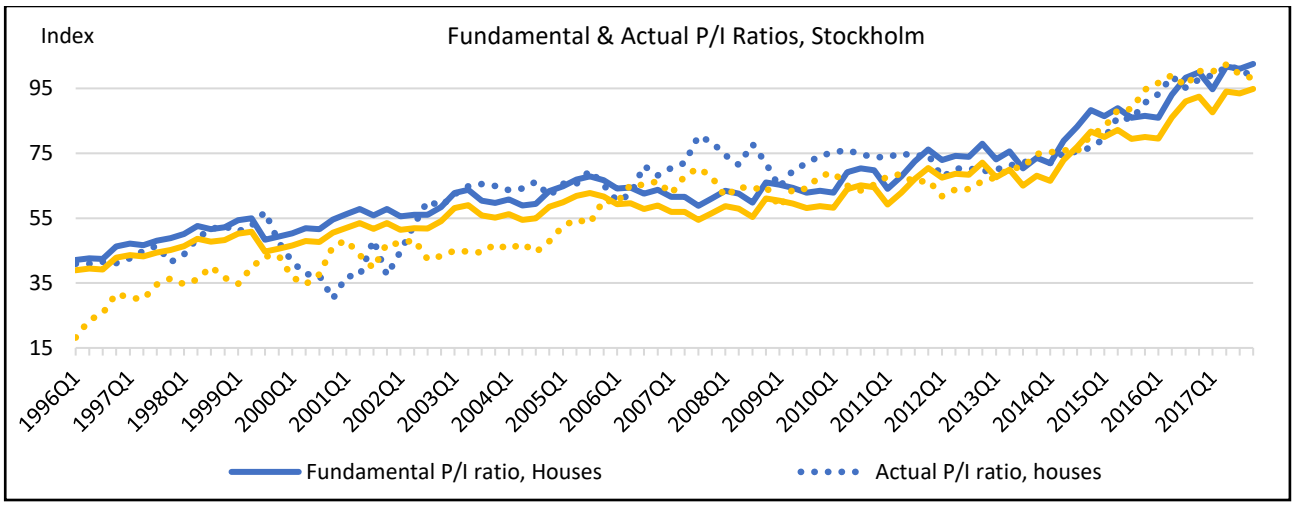
To separate the impact from change in various fundamentals on house prices a thorough analysis of fundamental factors will need to be conducted in order to evaluate whether they are sustainable. Accordingly, such fundamental factor analysis will follow this empirical analysis.

[6] In *Housing Taxation - Copenhagen*, the expected impact of the new tax reform is discussed in detail.

6.4.3 Stockholm

Figure 0-17 illustrates the historical development of the actual and fundamental P/I ratios with respect to houses and flats in Stockholm, between 1996Q1 and 2017Q4.

Figure 0-17 - The development of the fundamental P/I ratio and the actual P/I ratio for houses and flats in Stockholm



Sources: Alfred Berg Asset Management, OECD.Stat, OECD iLibrary, OECD Data & The Riksbank and own calculations – see appendix 6.10

As figure 0-17 illustrates, all P/I ratios in Stockholm have had an overall positive trend and the trajectories reveal how the actual P/I ratios have experienced a more volatile development. The ratios for the two categories of dwellings almost illustrate oscillation with the actual and fundamental ratios crossing each other several times although with irregular variation in magnitude. The persistent parallel shift between the fundamental P/I ratio for flats and houses is caused by a property tax incentive provided to owners of flats since its implementation in 2000.

The development in the P/I ratios for flats in Stockholm indicate a considerable undervaluation from the beginning of the examined period until 2006Q1. This can most likely be ascribed to the Banking Crisis in Sweden in 1992. The crisis came on the back of an insatiable credit demand led on by a deregulation of the credit market in 1985 and low interest rates (Enström, 2005). The crisis caused a recession and accompanied decreases in house prices, but evident from figure 0-17 the price for houses in Stockholm deviated considerably less from its fundamental value, compared to flats. In the following three years, the actual P/I ratio exceeds the fundamental one indicating bubble tendencies. Despite that the majority of the economic factors included in the fundamental P/I ratio develops favourably for homeowners (i.e. a decrease in user cost), the development in the actual P/I ratio is still unsupported. As was argued in the case of Copenhagen, this deviation could be driven by individual's strong expectations about future real house price increases. Another explanation to this deviation could be found in the disconnection between house market prices and the tax burden. In 2008, a reform changed the policy for property taxation in Sweden, transforming the tax to

an advantageous fixed charge for the majority of homeowners (see *Housing Taxation, Stockholm*). In the calculation of the fundamental P/I ratios for Stockholm, such tax ceilings are not accounted for and thus, a more precise estimate would have shifted the fundamental ratios upwards from 2008 and onwards. It is possible that a more precise measure of the effective property tax rate, could explain and decrease the gap between the two ratios.

Stockholm, and Sweden, also possess a unique tax feature compared to the other two capitals as a part of the realised profit from selling a dwelling is subject to a capital gain tax.[7] This particular taxation is unaccounted for in the fundamental P/I ratio for Stockholm, as the thesis will maintain the original measure for expected capital gains, outlined by Porteba (1992). However, policymakers in Sweden have on two accounts increased the tax on capital gains since 2001 and this would imply the true user cost of owning a dwelling in Stockholm is higher than the development plotted in figure 0-17. Knowing this, the deviation from 2010Q4 to the most recent observation should be more prominent than illustrated in the graph above, but it is possible that the contrasting effect from the lower fixed property tax evens out the impact on the user cost. Nevertheless, the deviation provides the thesis with a formal measure of characterizing that flat prices are overvalued in this period.

Comparatively, the development of the P/I ratios for houses in Stockholm also illustrate significant overvaluation during the financial crisis, interestingly reflecting stronger bubble tendencies compared to flats in this period. After a short-lived intercept of the two P/I ratios for houses the development again indicates an overvaluation from 2009Q2 to 2011Q3, although it is weaker than the previous period. The ratios yet again return to demonstrate undervaluation for the next two and half years. Sharply decreasing interest rates are driving this gap, and despite that inflation dropped to negative rates, houses prices relative to income did not increase as much as fundamentals would have prescribed. This is unexpected considering that house prices in Sweden experienced one the steepest climbs of all EU member states between 2012 and 2016, with real house prices rising with 28% (Gaál, 2017). During 2015 and 2016 the ratios intersected, deviating in the opposite direction and especially flats now seemed overvalued. A possible reason was the diminishing volume of flats and houses in Stockholm available on the market, which could be an indication of individuals' firm belief in future house price increases and therefore they were reluctant to realise the value of their dwelling (Østrup, 2016). A similar tendency was identified during the period leading up to the burst of the bubble in the Copenhagen housing market in 2007. It is accordingly a worryingly signal to market observers because it demonstrates how future expectations are driving the behaviour of individuals. This is a key criterion to the formation of house price bubbles (Case & Shiller, 2004 & 2012).

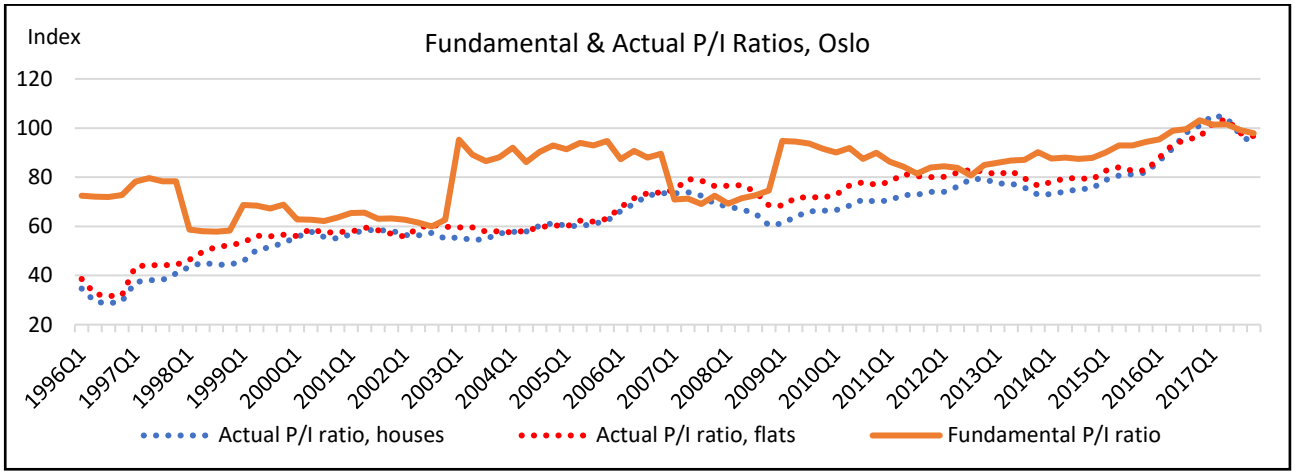
[7] Norway imposes a similar tax on capital gains from housing, however individuals will be exempt if they adhere to certain requirements.

Recent developments in two ratios for houses provide the thesis with a blurred interpretation of the affordability and sustainability of house prices in Stockholm as the ratios oscillate. This could be interpreted as an equilibrium state because prices are fluctuating close to their fundamental values. A critique of this assertion would be that the historic high level of house prices is a product of unusual and unfairly low interest rates, calling for fundamental adjustment to come. In either case, the thesis will take note that the actual P/I ratios for flats and houses are way above their previous peak in 2007Q3.

6.4.4 Oslo

Figure 0-18 illustrates the historical development of the actual P/I ratios for flats and houses in Oslo, as well as the fundamental P/I ratio applicable for both types of dwellings. The development is shown from 1996Q1 to 2017Q4.

Figure 0-18 - The development of the fundamental P/I ratio and the actual P/I ratio for houses and flats in Oslo



Sources: Alfred Berg Asset Management, OECD.Stat, OECD iLibrary, OECD Data, NTA and own calculations – see appendix 6.11

The development in the ratios illustrated in figure 0-18 above follow a general positive trend as Stockholm and Copenhagen did. Evidently, in the case of Oslo the development in the fundamental ratio is more volatile than the actuals, with numerous hikes and sharp falls during the period. To a large extent this outcome is rooted in an imprecise measure for the interest rate on mortgages loans in the analysis. For instance, the sudden spike in the fundamental P/I ratios in 2003Q1 is due to the fact that the applied nominal mortgage interest rate is almost cut in half. This reflects the limitation of applying historical average annual values for interest on all loans, but unfortunately the more specified mortgage interest data is only available from 2013 and onwards (see appendix 6.11).

In the beginning of the examined period, both houses and flats are characterised as significantly undervalued. The low level of the actual P/I ratios could be a lagged effect from the severe economic downturn in Norway that came off the back of the Norwegian Banking Crisis between 1988 and 1992. The crisis was triggered by

a variety of factors, but namely a credit boom due to low interest rates that were politically regulated to be below market rates played an important role (Grytten & Hunnes, 2014). From 2000 to 2003, figure 0-18 illustrates how the actual P/I ratios and the fundamental one follows a similar development, indicating house prices are in line with fundamentals. The equilibrium state is abolished by the aforementioned interest rate hike in 2003 which was an attempt from policymakers to regulate a strong growth in house prices. From figure 0-18, the effect from the regulation is illustrated by the deviation that indicate that house prices were undervalued from to 2003 to 2007. The increased interest rates resulted in decreasing house prices in the late half of 2007 (see figure 0-13 – development in underlying factors) thus, price declines were a reality in Norway prior to the financial crisis which unfolded globally from the collapse of Bear Stearns in March 2008 and cemented by the bankruptcy of Lehman Brothers in September 2008 (Østrup *et al.*, 2009). The regulation and Norway's less exposed financial sector are demonstrated by the development in the P/I ratios for Oslo as the deviation only indicates overvaluation of flats in 2008Q3 during the entire period of the global financial turmoil. The development of the actual P/I ratio for houses indicated overvaluation prior to the crisis but not during. This development is quite different from the deviations identified in Stockholm and especially Copenhagen. The fundamental P/I ratio dropped in 2009 as cuts in interest rates were made, presumably to ensure the economy's less turbulent passage through the financial crisis.

Differently from the two other Scandinavian capitals, the development in the P/I ratios indicates more occasions and longer periods of undervaluation. Amongst other factors, this could be a result of the missing property taxation in Oslo up to 2016. From 2016, a property tax has been introduced but is only a minority of households that in practise have paid the property tax (this is elaborated upon the Housing Taxation section for Oslo). Evidently, the deviation from the fundamental P/I ratio exceeding the actual P/I ratio is mainly motivated by progressive reductions in the capital income tax rate and secondly due to decreases in interest rates. Despite the fact that real house prices in Oslo grew in this period, according to changes in fundamentals they were still undervalued. However, recent observations indicate that house prices are closely related to underlying economic factors, as the ratios have found a similar level. As pointed out in the analysis of Copenhagen and Oslo, one still has to question whether the level of fundamentals is in fact sustainable. Figure 0-18 accordingly illustrates that the P/I ratios are at historical peaks before the correction in house prices in 2017 in Oslo. The question to market observers is whether the correction was adequate or further correction will follow in the near future.

6.4.5 Conclusion and critique

The analysis of the development in the fundamental and actual P/I ratios for Copenhagen provided a very strong and clear indication of bubble tendencies between 2004 and 2009. The development indicated that the bubble formation lasted longer for one-family houses compared to a more rapid rise and fall in the case of

flats. As increases in house prices have gained a steady pace since 2012, the development of the ratios has switched from indicating prices are undervalued to indicate overvaluation from 2017Q2, both in the case of flats and one-family houses.

The P/I analysis of Stockholm revealed that up to 2006, prices for flats seem considerably undervalued. The interpretation of the development of P/I ratio for houses was less clear in this period, but prices seem to be supported by underlying fundamentals except for an undervaluation between 1999Q3 and 2002Q3. During the financial crisis, the analysis provided a stronger indication of a bubble for houses in Stockholm compared to flats. Post-crisis, house prices in Stockholm have soared and to some degree this growth have been supported by favourable changes in fundamentals. However, from 2015 a deviation between the fundamental P/I ratio and the actual P/I ratio for flats have indicated considerable overvaluation, despite the house price correction in the second half of 2017.

The development of the actual P/I ratio for flats and houses compared to a joint fundamental P/I ratio for Oslo, identifies more occasions of undervaluation rather the opposite. Seemingly this is due to policymakers' regulation of interest rates leading up to the global financial crisis, as well as afterwards. Since 2014, the gap between the actual P/I ratios and the fundamental one have narrowed with increasing house prices and in 2017 the deviation indicated a slight overvaluation. The overvaluation was then discarded following a real house price correction in Oslo.

Several short-comings and questionable assumptions embedded in the P/I ratio framework have been highlighted throughout the empirical P/I analysis. The ambiguity of the equilibrium condition makes it difficult to conclude the actual presence of a bubble in the housing market. As a result, the framework can only provide strong or weak indications of such. Furthermore, access and availability of local data on all variables in the model would have been desirable. Instead a mixture of national and local values is applied which weakens the estimate of the development of the true local affordability of housing.

The economic factors that comprise the user cost of owning a dwelling within the framework are generally considered as important fundamentals. However, the analysis excludes several other factors significant to the development of house prices. Accordingly, economic factors such as unemployment rate, population and credit growth to name a few, will be analysed in the following section.

7. Comparative Fundamental Factor Analysis

In this section, the paper will provide a comparative analysis of several factors which is believed could have impacted the recent house price growth in all of the Copenhagen, Stockholm and Oslo housing markets. The analysis will help in determining whether the fundamental factors support the growth in house prices within the respective cities. The paper will evaluate the developments of six factors which are believed are most

attributable to the recent growth in house prices. These are developments within interest rates, unemployment levels, Gross Domestic Product (GDP), the credit market, new constructions, and housing taxation. International comparisons will also be applied when analysing some factors when deemed relevant. Due to the limited scope of this paper, fundamentals concerning the demographic and psychological factors will not be discussed.

7.1 Interest Rate

Many academics tend to be in agreement that interest rates are one of the most significant macroeconomic factors in driving housing prices (Goodhart & Hoffman 2008, Zan & Wang, 2012, Tsatsaronis & Zhu, 2004). Interest rates can have a powerful impact on housing prices, primarily because they influence individuals' ability to purchase housing. For prospective homeowners, lower interest rates imply that the cost of borrowing is cheaper which makes it more attractive for individuals to purchase housing. For current homeowners, reductions in interest rate levels benefits variable mortgage holders as it decreases their monthly mortgage payments, leaving them with greater disposable income. In the recent past, low interest rates played a part in planting the seeds of the financial crisis and fuelling the housing bubble in countries such as Ireland, Greece and Spain, because it spurred excessive risk taking by both individuals and financial institutions (Ferrero, 2015). Since then, however, it should be noted that governments and financial institutions have implemented new regulations to prevent such reckless lending occurring whereby the minimum deposit percentage for mortgage loans has been increased. This will be elaborated upon further in section.

7.1.1 The Key Policy Rate

The key policy interest rate (CBPR) is the rate that central banks set in order to implement or signal its monetary policy (IMF, 2018). Due to varying objectives, the underlying financial instrument which is adopted in establishing interest rate levels differs between countries. For example, in some countries the CBPR is a lending rate while in others it is a discount rate. Most importantly, the policy rate influences the other interest rate levels for the rest of the economy. For, changes in the CBPR affects the money-market interest rates directly and via the money market, it also affects the lending and deposit rates indirectly, which are set by banks to their customers (ECB, 2016). Central banks will alter the CBPR in order to guide the economy in a particular direction. As such, central banks can follow contractive or expansive monetary policies by altering their interest rates. Raising interest rates can be used as a means of curbing excessive credit growth and encouraging saving. On the other hand, reducing interest rates fosters credit expansion and helps households in bearing higher debt capacity, which in turn helps to boost housing prices.

7.1.1.1 Denmark

Danmarks Nationalbank or Nationalbanken is responsible for setting the monetary policy interest rates in Denmark. The primary objective of its policy is to safeguard the stability of its own currency. It does this by maintaining a fixed exchange rate policy with respect to the euro area, maintaining a central rate of DKK746.038 per EUR100 with a variation band of +/- 2.25% (Nationalbanken, 2017). In order to sustain this fixed-exchange-rate-policy, Denmark adjusts its key interest rate in line with the ECB's key interest rate. This is done using a spread between its lending rate and its rate of interest on certificates of deposit and adjusting its rate of interest on certificates of deposit accordingly. For this reason, its rate of interest on certificates of deposit is regarded as the key governing interest policy rate (Spange & Toftdahl, 2014). In comparison, the ECB's key policy rate is its refinancing (refi) rate which is the price that banks pay to borrow funds. Thus, Nationalbanken will raise or lower its rate of interest on certificates of deposit when the ECB changes its refi rate. This in turn affects the lending and deposit rates offered to customers (Nationalbanken, 2017).

7.1.1.2 Sweden

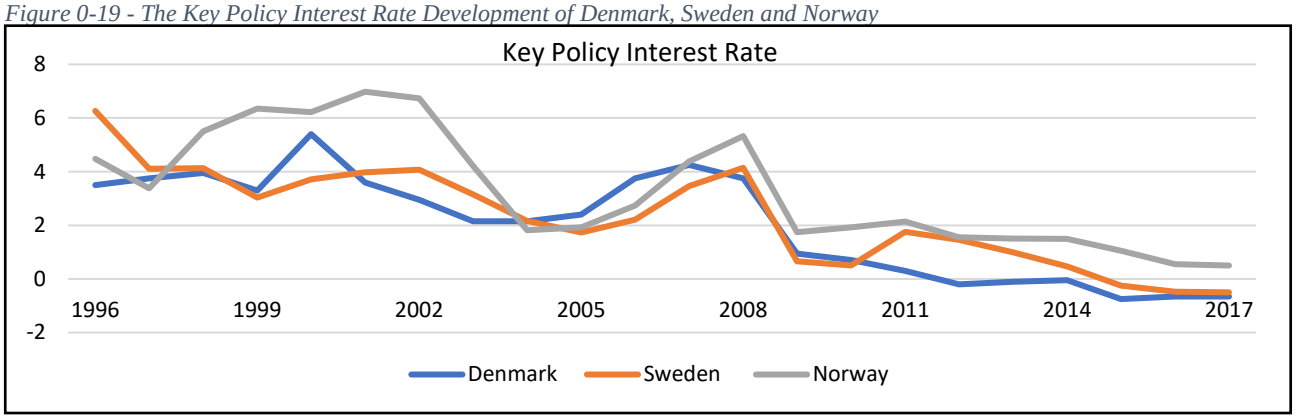
In Sweden, the Riksbank is responsible for conducting its monetary policy. The primary aim of the Swedish central bank is to maintain price stability by means of having low and stable inflation levels. This is deemed to be of paramount importance as price stability creates conditions for desirable sustainable growth. In particular, it benefits households in making sounder economic decisions and sets a platform for efficient price-setting (Riksbank, 2018b). Conversely, high and deviating inflation creates uncertainty over how prices will develop in the future. This can lead to interest rates and thereby borrowing costs being more sizable than what would otherwise have been the case (Riksbank, 2018b). Riksbank sets an inflation target of 2% annually. The repo rate is used as an important mechanism of achieving this. This is the interest rate at which banks can borrow or deposit funds for a period of 7 days with the Riksbank (Riksbank, 2018c). This is relevant from a housing perspective as by changing the repo rate, the Riksbank exerts influence over the interest rate levels which banks apply to mortgage loans.

7.1.1.2 Norway

Norway's monetary policy is managed by the Norwegian central bank – Norges Bank. Alike the Swedes, Norway's monetary policy is to keep inflation low and stable, with the country also having the identical target inflation level of 2% over time. This recently came into effect in March 2018 after the Norwegian government implemented new regulation on monetary policy whereby the new inflation target was to be reduced from 2.5% to 2% (Norges Bank, 2018). While their goals are akin to the Swedish central bank, their underlying financial instrument for the key policy rate differs. Since 1993, Norway's key policy rate has

been its sight deposit rate. This is the interest rate on the bank's reserves up to a stated quota. Its key policy rate will normally have a strong impact on the shortest money market rates as well as the banks' deposit and lending rates (Norges Bank, 2018).

Figure 0-19 - The Key Policy Interest Rate Development of Denmark, Sweden and Norway



Sources: Nationalbanken, Riksbank & Norges Bank.

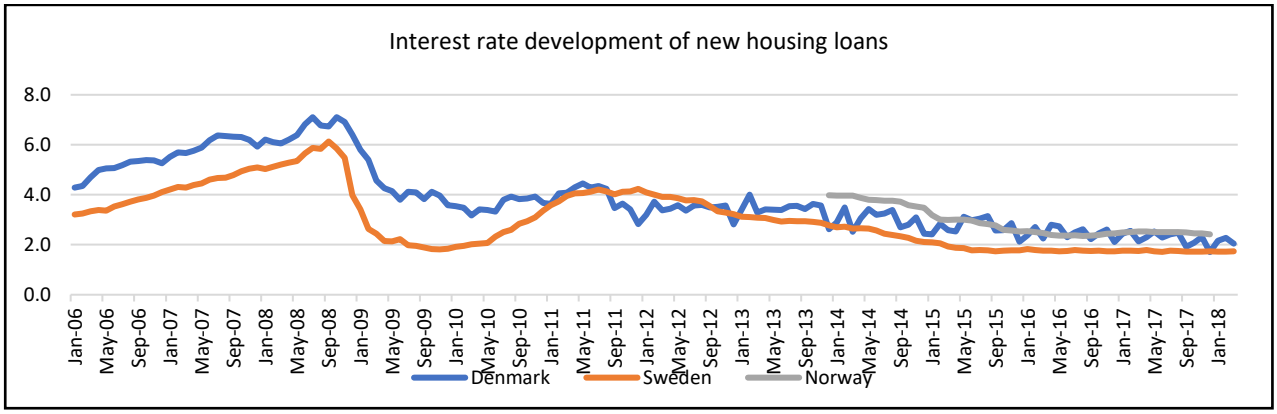
From figure 0-19, we can see that the Norwegian and Swedish CBPRs have overall been at higher levels than their Danish counterparts. From 1996 until 2002 the progression of the CBPR in Denmark, Sweden and Norway each followed very different trajectories as the timing of rate cuts and hikes often differed. However, it is fair to say that since 2002 the key policy rate in all three countries has generally been progressing in the same direction. Following rate cuts which began in 2002, the difference between the three rates was far less by 2004, differing by at the most 0.34%. In the same year we saw the beginning of hefty rate increases in both Denmark and Norway while rate increases were implemented in Sweden the year later. By 2007, Norway and Sweden's rates had more than doubled from their 2004 and 2005 levels, while Denmark's had increased by 77%. Despite these rate increases, housing prices increased substantially in all three capital cities during this period, particularly in Copenhagen where prices increased by more than 50%. In this instance, there is a good indication that housing prices were not supported by this fundamental factor over this spell.

As a consequence of the financial crisis in 2008, these rate hikes were soon reversed with all three central banks cutting their rates drastically. Since that time, the CBPR has generally followed a downward trend with rates reaching historically low levels in all three countries, coinciding with the high growth in housing prices over the same period. Hence, it can be argued that the house prices in all three cities can be explained by this fundamental factor over this interval.

7.1.2 Mortgage Rates

As previously outlined, the key policy rate affects the central bank's lending rate. The lending rate is in turn incorporated into banks mortgage rates. Mortgage rates represent cost of borrowing to purchase real estate. The rates are set based on an underlying risk-free rate (lending rate), which is set by the country's central bank, a risk premium reflecting the mortgage lender's credit worthiness and a mortgage spread (Nordea Markets, 2017).

Figure 0-20 - The interest rate development for new housing loans for Denmark, Sweden and Norway



Sources: Nationalbanken, Riksbank & SSB

In recent times, the Scandinavian mortgage market has been characterized by an ultra-low interest rate environment. The "Nordic mortgage interest rates have fallen from at above 20% at one point in the early 1990s to below 5% for most of the past 15 years, and down to below 3% for the past five years" (Nordea Markets, 2017) These low interest rates have eased financing conditions and supported the housing price growth in the three countries. It has given current home owners greater economic flexibility to increase instalments on existing loans, while also enhancing their ability to increase debt by borrowing against home equity, in addition to bolstering their capacity to purchase more expensive real estate.

The worry for many is if borrowers have become too accustomed to these favourable rates. For, the low interest-rate landscape is one of the key explanatory factors behind why household debt has in recent years stood at historically high levels in most OECD countries. Denmark, Norway & Sweden all rank in the top ten of OECD countries with the highest percentage of household debt to income. This indicates that their indebted homeowners will be particularly vulnerable to any interest rate shocks, as when rates increase, so too will the cost of servicing debt. According to Svensk Fastighetsförmedling, even modest interest rate increases in Sweden's case would expose tens of thousands of households to severe financial difficulty. They estimate that almost half of Swedish homeowners would have to sell their home if their debt costs increased by SEK 3.000 per month (Business Insider Nordic, 2017).

7.2 The Credit Market

Housing is deeply ingrained in and influenced by credit markets, as most home purchases are financed by mortgage credit (Wachter, 2016). Accordingly, Borio *et al.* (1994) argues that a strong relationship exists between the availability of credit and housing prices. A well-functioning credit market is therefore vital for households as it gives them the ability to finance their housing investments. Thus, it is reasonable to suggest that developments within the housing market and the credit market should be closely linked.

Banks and other financial institutions have the ability to adjust the supply of credit. This affects the demand and price of housing, meaning that these institutions are capable of firing up or cooling down the housing market depending on the supply of credit they do or don't give to households. For example, banks can potentially block households from the housing market by limiting their access to credit. As more households have restricted access to credit, the demand for homes will decrease, pushing prices down. In contrast, if these institutions increase the number of mortgage loans granted to customers, this will lead to an increased demand for housing, which in turn increases housing prices. It is also important to highlight that the political conditions can play a key part in the rationale behind such changes in the supply of credit. This will be discussed in detail later in this section. This chapter will review the uniqueness the Danish mortgage system before then moving on to analyse the credit development by examining the debt ratios of households. Additionally, interest rates, loan types and government regulations are important factors which will be discussed.

7.2.1 The Danish mortgage credit system

It would be beneficial for the reader to gain an understanding of the Danish mortgage system and the mechanisms that differentiate it from other international mortgage markets. First of all, a mortgage bond is an instrument of debt secured against mortgages on real property and is a negotiable security where the price of the bond is determined by supply and demand in the open market. This is unique to the Danish mortgage credit system as interest rates on mortgages are negotiated between the mortgage bank and the borrower in other economies. Originally, the system was founded on principles of joint liability rather than commercial banking activity and regulation of mortgage institutions was first introduced in 1850 (Østrup, 2017). The intention was to provide cheap financing to Danish home-buyers. Regulation have ensured a unique feature to the Danish mortgage system in an international perspective. The so-called *balance principle* prescribes that the mortgage institutions will finance the mortgage by issuing a covered bond with identical terms of maturity, interest rate and repayment profile of the mortgage provided to the borrower. This principle is also known as *match funding* and reduces the risk taken on by Danish mortgage institutions to a credit risk as long as the bond is issued. The prudential principle is beneficial for the financial stability in Denmark as it

limits the possibilities of the institutions exposing themselves to interest rate, liquidity, foreign exchange and option risks (Nationalbanken, 2015b).

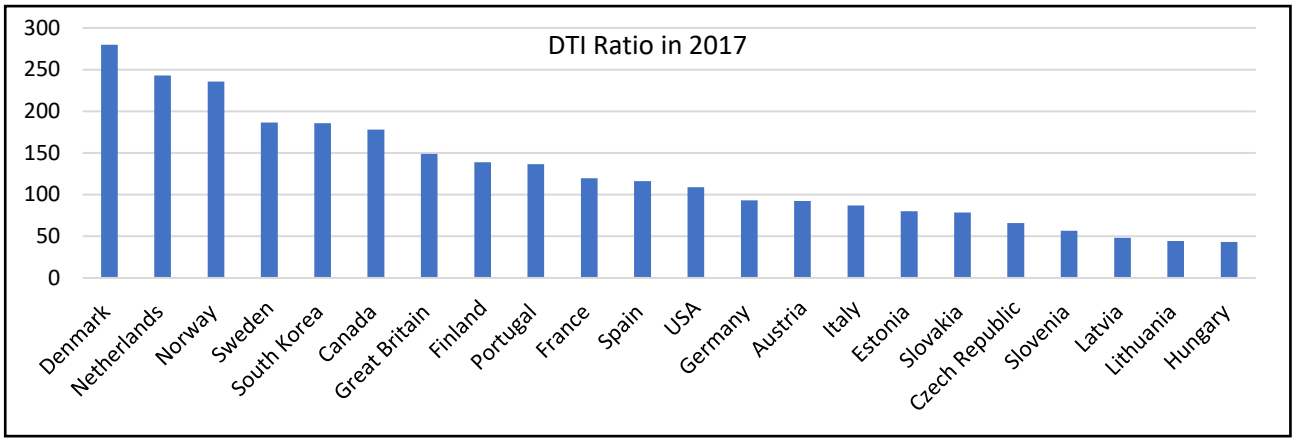
The issuer of the bond usually reserves the right to demand foreclosure of the property, should the mortgage borrower fail to pay all principal and interest payments due. Along with other principles imposed by regulation, this provides increased security to the bondholders and accordingly they will demand a relatively lower risk premium on mortgage bonds. However, regulation on the Danish mortgage system have become increasingly more lenient within the last two decades. Financial innovations such as the introduction of mortgages with non-amortization in 2003 and the increased proportion of mortgages with adjustable rates have weakened the financial robustness of the Danish mortgage market (Østrup, 2017).

7.2.1 Credit Development

In order to examine the development of the credit market, one can look at several different factors that might indicate its progression. In this paper, we have chosen to focus on credit growth by looking at the debt-to-income (DTI) ratio and its development over time. Credit development is primarily determined by the demand and supply of credit. When reviewing mortgage applications, lenders assess both borrowers' wealth and their ability to service debt in order to assess the risk of default. Household wealth and the ability to service debt are thus the main factors influencing credit growth (Arestis & Gonzalez, 2014). Accordingly, the credit growth within a country can indicate how quickly households' total debt is increasing, which in return gives an indication of the housing market development. Recent studies (Crowe *et al.*, 2011) have highlighted that many recent banking crises which co-occurred with property busts were preceded by an accelerated increase in household leverage and credit growth. It is therefore relevant to analyse the development of the debt to income ratio for the three respective Nordic nations to see if they replicate having similar characteristics.

As determined previously, house prices within all of the Copenhagen, Oslo and Stockholm markets are currently at very high levels. Thus, we find it appropriate to discuss recent credit growth for households which can be done by looking at their debt as a percentage of disposable income, also known as the DTI ratio. The growth in the debt ratio is affected by a number of factors such as GDP growth, growth in disposable income, low unemployment levels, low lending rates, positive future expectations among households as well as higher house prices. As touched upon earlier, the purchase of a house is usually the biggest investment an individual will make. Therefore, the development of household debt will largely follow the progression of movement in the housing market.

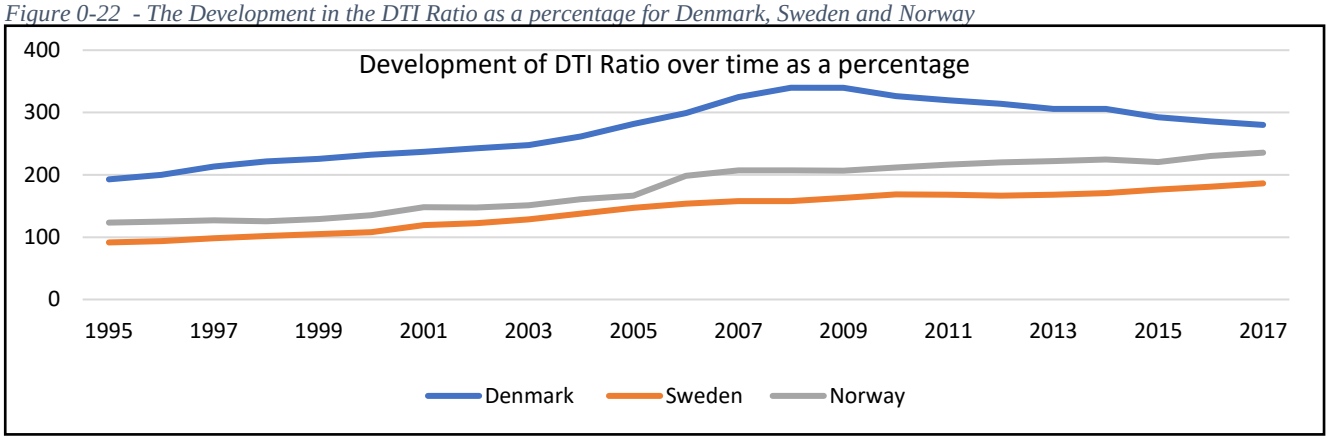
Figure 0-21 - DTI Ratio in selected OECD countries as of 2017



Source: OECD

As shown in Figure 0-21 above, the DTI ratio among households in Denmark, Norway and Sweden towers above almost all other OECD countries. Looking at how these Nordic countries compare internationally, the high debt burden in all three countries makes households particularly vulnerable to sharp increases in mortgage rates and/or if the household is faced with unpredicted events such as unemployment or illness.

Figure 0-22 - The Development in the DTI Ratio as a percentage for Denmark, Sweden and Norway



Source: OECD

The DTI ratio progression in the three Nordic countries, as shown in the graph above, has seen an overall increase over time caused mainly by strong economic growth and optimistic expectations to the market. The increase in DTI can be partially attributed to the credit policies in each of the respective three countries, which we will elaborate upon in the following sections.

7.2.3 Loan-to-Value Ratio

The loan-to-value ratio (LTV ratio) is a calculation that helps lenders determine the level of exposed risk they take on when underwriting a mortgage. The ratio evaluates how indebted the household is by quantifying the value of the mortgage relative to the appraised value of the property. LTV restrictions are thus used by banks in order to limit the allowance of mortgage credit beyond a particular fraction of the value of housing collateral.

$$LTV\ Ratio = \frac{Mortgage\ Amount}{Appraised\ Value\ of\ the\ Property} \tag{7.2}$$

A high LTV ratio indicates that the majority of the property is financed with debt, and in some cases the mortgage may exceed more than 100 per cent of the value of the property. Once a mortgage is drawn down, the LTV ratio is constantly fluctuating as a result of changes in both the market value of the property and in the nominal value of the debt. Accordingly, price changes in the real estate market as well as changes in interest rates can lead to the LTV ratio becoming extremely volatile.

A prime example of this was seen in the latest Financial Crisis, where in the years leading up to the crash, individuals in a number of European countries such as Ireland could borrow 100% of the value of the property. Following the crash, many borrowers then faced the realisation that they could now sustain their payment schedule, coupled with the erosion of the loan to value of the mortgage as a result of a depreciating house prices, leading to adverse ramifications. In some instances, there was no equity built up within the property as it was financed solely by debt. Once housing prices tumbled, the LTV ratio was now above 100% in many cases, resulting in households becoming even more extremely indebted. The negative equity scenario which some homeowners were now faced with, together with a fall or loss of income in some circumstances meant that some homeowners defaulted on their mortgages and resulted in the foreclosure of properties. It was often the case that lenders incurred a loss on the transaction as the proceeds from the sale of the property did not cover the balance of the mortgage. High household debt results in the economy being more sensitive to asset price movements, highlighting the vulnerability of households and the economy as a whole, since shocks and macroeconomic instability are amplified (Gaál, 2017).

The destructive nature that this has had on many European countries highlighted the need for lower LTV ratios that could reduce the vulnerability of financial institutions at origin. According to the IMF, the rationale behind having limits on LTV ratios is to lessen the “risks generated by strong credit growth and

credit-driven asset price inflation" (Lim *et al*., 2011). Additionally, the Committee on the Global Financial System (CGFS, 2012) suggest that LTV cap tightening should be used to reduce the vulnerability of banks at source by restraining the leverage of borrowers and credit growth.

Table 1 - FSA Requirements for Loan-to-Value Caps for Mortgages in Denmark, Sweden and Norway

Country	**LTV, %**	**Introduced**	**Max LTV, % as of 2005 (Before Financial Crisis)**
Sweden	85 %	2010	95 %
Norway	85 %	2015	100 %
Denmark	95 %	2015	80 %

Source: Nordea Markets & Neytendasamtökin

Accordingly, there is a growing consensus that mortgage banks LTV policies play a significant role in mitigating against the systematic risks which are associated with credit-property price spirals (Wong & Tsang, 2016). While this is the case, it also on the other hand means that LTV policies can contribute to the procyclicality of the housing market (Christensen *et al*., 2011). Previous studies have supported the ideology that LTV policies can intensify swings in the housing market, and by doing so can worsen boom-bust cycles. Using data from 44 U.S cities over a ten-year period, Lamont and Stein (1999) showed that in those cities with higher levered (high LTV ratio) homeowners, the sensitivity of house prices to income shocks was higher. Further, Almeida, Campello, and Liu (2006) analysed the international variation in the maximum LTV ratios over a thirty-year period and found that the differences in the maximum ratios can explain the variations between the countries in the sensitivity of house prices and credit demand to income shocks. They refer to high maximum LTVs as having a "financial accelerator" effect. Over the boom period of 2003-2006, all households including constrained households received a positive income shock in the form of increased house prices. The increase in prices meant that borrowers increased their lending capacity in the process.

If constrained households receive a positive income shock that boosts housing prices. The higher the LTV ratio that households can achieve, the higher the increase in borrowing capacity that is generated by the ensuing increase in prices. Importantly, the procyclical increase in borrowing capacity may allow households to further increase housing spending, amplifying the collateral-based spending cycle.

With increasing housing prices, lending would be seeing more affordable to borrowers with poor credit

histories (Muellbauer & Murphy, 2008). If a borrower was not able to pay a mortgage cost, a lender might liquidate a house and gain a return. That was a rational explanation in lending to low-income families (Green & Wachter, 2007; Allen & Gale, 2007). Thus, the viability of these loans depended almost entirely on rapid appreciation in house prices (Hoenig, 2008). This belief prompted irrational behaviour within lenders, such as dramatically loosening credit standards, lending more against each property and cutting the need for documentation (Nationalbanken, 2007).

7.2.4 Mortgage Regulations

In order to avoid excessive mortgage lending and related problems, the Scandinavian countries have all implemented a series of policy measures to mitigate risks for the financial system. These macroprudential regulations were set in place by the Nordic Financial Services Authorities (FSAs) and each country has put their own specific set of policies in place as a result. In this section, we will cover the mortgage regulations and bank policies put in place for Sweden, Norway and Denmark respectively. An overview of all the regulations mentioned in this section can be found below.

Table 2 - FSA Requirements for Mandatory Mortgage Amortisation in Denmark, Sweden and Norway

Country	LTV, %	Introduced
Sweden	LTV > 70 %: 50 years LTV 50-70 %: 100 years LTV < 50 %: None	2016
Norway	LTV > 60 %: 40 years*	2015
Denmark	None	N/A

*The LTV threshold was decreased from 70% to 60% in January of 2017

Source: Nordea Markets

7.2.4.1 FSA Regulations - Sweden

Sweden was the first of the Nordic countries to adopt the new regulations and their strict approach inspired the policies later set by the two other countries. The loan-to-value (LTV) cap for retail borrower's mortgages was set at 85% in 2010, which meant that in using the property as collateral for the mortgage, it would no longer be possible to borrow any more than 85% of the property's estimated market value. Since the specific implementation of the new macroprudential regulations is up to each country, not all chose to make the LTV limit a legal requirement. In Sweden, the LTV limit was put in place as a guideline which it was strongly

recommended to follow. Meanwhile, the LTV limit was implemented as a legal requirement in Denmark and Norway in 2015 (Farelius & Billborn, 2016).

New minimum risk weights were set in 2014 for calculating the banks' reserve capital requirements. The banks' risk models are based on historical credit loss, and decades had passed since Swedish banks were last affected by any significant credit losses. Even during the big Swedish banking crisis in the early 1990s, losses from Swedish retail lending were close to insignificant. As such, the existing models for calculating reserve capital requirements against lending would not create a need for the banks to build bigger reserve buffers. However, the models did not take important factors such as rising household leverage and record-high residential property prices into account. Therefore, in 2014 the FSA increased the minimum risk weights for calculating the banks' reserve capital requirements on mortgage loans from 15% to 25% following an increase two years prior from 5% to 15% (Nordea Markets, 2017). Lastly, from 2016 the Swedish FSA regulations also included a mandatory amortisation requirement for all new mortgages with an LTV ratio of 50% or above (Farelius & Billborn, 2016).

7.2.4.2 Bank Mortgage Lending Policies - Sweden

In addition to the new FSA regulations, Swedish banks implemented their own set of requirements for households looking to borrow. As an example, households looking to borrow from Nordea must be able to service the mortgage at an interest rate that equals the fixed five-year mortgage interest rate + 3 percentage points (and never less than 8% in total). Nordea also requires borrowers to theoretically be able to pay off the entire mortgage within 50 years (Nordea Markets, 2017). However, as mentioned in the previous section, since May 2016 only mortgages with an LTV of 50% or above have to be amortised.

7.2.4.3 FSA Regulations - Norway

The Norwegian FSA regulations also began with a mortgage LTV cap of 85% (IMF, 2016). This policy was implemented almost five years after it was implemented in Sweden, in July of 2015. The implementation of the Norwegian FSA regulations continued to closely follow the Swedish implementation, although slightly delayed. In this context, it is worth noting that the increase in house prices over the past 10 years have also looked very similar in the two countries. The Norwegian house prices have increased by 59% while the Swedish house prices went up by 71% in the past decade.

Similar to the Swedish market, Norwegian banks' models for calculating the bank's reserve capital requirements overlooked important factors and needed to be updated. In this area, Norway introduced new regulations before Sweden did and in as early as 2013 the banks' minimum risk weights for calculating reserve capital requirements was almost doubled on mortgage loans, going from 10-15% to 20-25% (Nordea Markets, 2017).

In 2017 tightened regulations were introduced for purchasing secondary apartments in Oslo. These regulations were implemented as a reaction to a dramatic increase in house prices in the Oslo market and required borrowers to present 40% of secondary, non-main residence apartment purchases in own equity. Previously, such investments required buyers to have at least 15%. These new regulations were put in effect for 17 months until June of 2018 (Nordea Markets, 2017).

Mandatory amortisation regulations were also introduced in the Norwegian market in July of 2015 in the face of rapidly increasing household debts (IMF,2016). Once again, these regulations were inspired by the Swedish market, where they were originally also planning to introduce these regulations in 2015 but postponed implementation until 2016 because of uncertainty about the mandate of the Swedish FSA. The requirements for mandatory amortisation for new mortgages in Norway said that full repayment in 40 years was needed if the LTV is 60% or above (equivalent to an annual amortisation of 2.5 percentage points of the total loan amount). Comparably, the Swedish amortisation requirement was only one percentage point of the total loan amount per year, equivalent to full repayment in 100 years if the LTV ratio was between 50-70%.

7.2.4.4 Bank Mortgage Lending Policies – Norway

Before the new FSA regulations were introduced in the Norwegian market, the banks had many of their own requirements for borrowers to meet in order to qualify for a mortgage. Following the implementation of the FSA regulations however, many of those requirements were no longer necessary for the banks. To once again use Nordea as an example, they ask their customers to meet only one requirement in order to qualify for a mortgage - an amortisation period of 30 years or less (Nordea Markets, 2017).

7.2.4.5 FSA Regulations – Denmark

The Danish LTV cap was set to 95% in November of 2015, which is significantly higher than in Sweden and Norway (Farelius & Billborn, 2016). This is currently the only FSA regulation in effect for mortgages in Denmark. The Danish market didn't experience problems with the risk weight for residential mortgages to the same degree as Norway and Sweden, so no regulations were put in place to manage it. Currently, the

average risk weight for calculating reserve capital requirements for banks is around 12% and there are no plans to change it.

It is however worth noting that other initiatives were put in place, which are unique to the Danish market. For example, in 2016 the Danish FSA created a new set of guidelines for mortgage credit assessments in rapid-growth areas such as Copenhagen and Aarhus (Nordea Markets, 2017).

7.2.4.5 Bank Mortgage Lending Policies – Denmark

Unlike its Nordic counterparts, Denmark's housing market is financed exclusively with long-term, fixed-rate mortgages. When a household decides to purchase a home, they are able to finance up to 80% of the property's value with a mortgage that has a maximum maturity of 30 years (IMF, 2014). If that is not enough and more financing is needed, the household can take out a higher interest loan for up to 15% of the property's value. This is not a traditional mortgage, but is restricted by the LTV cap of 95% set in place by the FSA, which is why the additional high-interest loan cannot exceed 15%. Even though this practice is not regulated by FSA or any other policies, it is an industry standard that has been in place for several decades (Nordea Markets, 2017). The next section will build on from this by outlining a number of further developments within the Danish credit market.

7.2.5 Credit Policies in the Danish Market

A variety of credit policies in relation to mortgages specifically in the Danish market have been put in place over the past two decades. These policies are unique to the Danish market and we will cover some of the most significant in this section. In particular, we will cover the interest-only mortgage introduced to the Danish market in 2003, with the purpose of discussing its influence on the future of the Danish market at a later point in this paper.

Financial innovation exclusive to the Danish credit market made it easier for many prospective first-time buyers to purchase housing. In 2003, legislation was passed by the Danish parliament allowing mortgage banks to offer deferred amortisation mortgages to customers. This new mortgage type – whereby for an initial period of 10 years only interest payments are made but the full amount still had to be paid over a 30-year-contract – increased the flexibility of mortgage financing. The new interest-only mortgages grew quickly in popularity and after only one year, 15% of all mortgages in the Danish market were of the interest-only type. Since 2010, over 50% of mortgages in Denmark have been interest-only mortgages (Nordea Markets, 2017).

Despite being considerably more expensive in total than the traditional mortgage alternatives, the first-year payments on interest-only mortgages are considerably lower. Furthermore, the mortgage can in some cases be refinanced, meaning that the 10-year interest-only period could be restarted down the line, which in turn prolongs the average repayment period (Gaál, 2017). By altering the repayment profile, this meant that individuals such as students and young adults, who were cash-constrained during these first years were now able to afford purchasing housing via this new financing mechanism.

In a recent development, Nordea introduced a new type of mortgage called Freedom30 in March of 2018. This 30-year interest-only mortgage has a variable interest rate and needs refinancing every 3 or 5 years with the respective interest rate. Furthermore, the loan requires that no more than 60% of the house value is financed. Other Danish financial institutions have adopted the product innovation and offers up to 30 years of interest-only payments, coupled with certain restrictions (Danske Bank & TotalKredit).

In 2016 the best practice guidelines for granting owner occupied mortgages to home buyers in large urban cities such as Copenhagen and Aarhus were introduced (Smidova, 2016). Furthermore, on the 1st of January 2018, new regulation came into effect in Denmark, for Denmark as a whole, with a more restrictive policy on the debt profile of the loan taker of a mortgage. The so-called 'good practice' notice for brokers of mortgage institutions, a transverse legislation put forward by Finanstilsynet. Specifically, a person with a debt level higher than four times of his or her yearly income are not allowed to obtain a mortgage if the debt to value exceeds 60%. Several local observers of the Danish housing market have pointed out how the new regulation most likely is an important factor to the stagnating sales volume, the market for owner-occupied housing in Copenhagen has experienced since 2018 (Information, 2018).

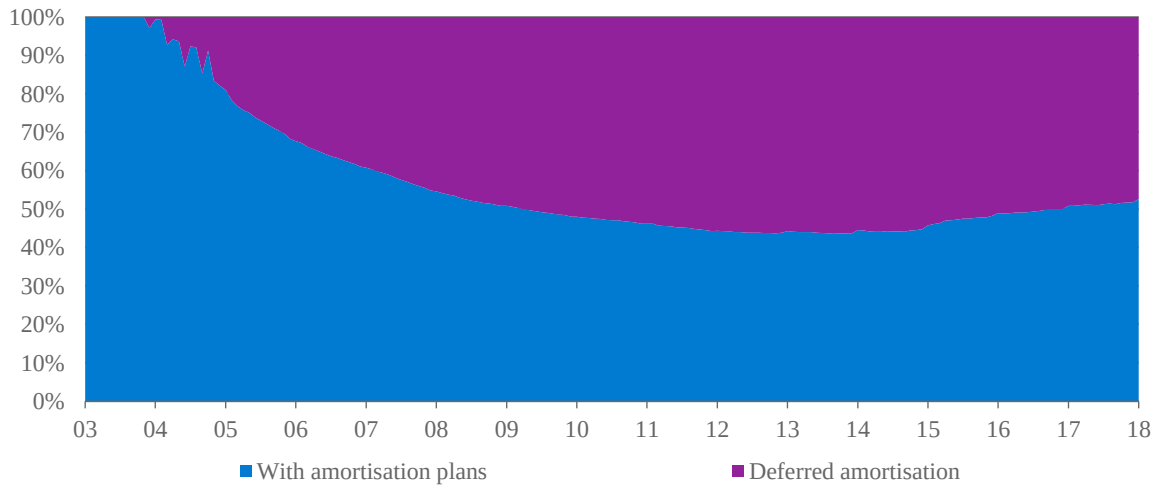
7.2.6 The Effect of Danish Credit Policies on the Country's Financial Health

As mentioned throughout this paper, several factors that are unique to the Danish housing market could potentially have detrimental effects on the future development of the market. In this section, we will touch upon some of the major topics that we find relevant when assessing the Danish housing market and the credit policies that are in place for mortgages.

Studies have previously linked product innovations in the mortgage market, such as the introduction of 10-year interest-only mortgages in 2003, to the crash of the housing market in Denmark in 2007. Extensive

research on the relationship between price developments and debt of private households finds that the interest-only mortgages contributed to the crash. Nationalbanken have conducted an analysis of various explanatory factors behind the 71% house price increase in Denmark between the 4th quarter of 1991 to the first quarter of 2007. For the entire Danish housing market, the analysis concluded how falling interest rates and increasing disposable incomes extensively drove the upswing during 2000's. However, introduction of new loan types in the form of adjustable-rate loans and deferred amortisation in 2003 are able to explain 46% of the increase in house prices (Dam *et al*., 2011a).

Figure 0-23 - The percentage of mortgages with amortisation or deferred amortisation in Denmark



Source: Nationalbanken

According to Peter Smith, Director of Nordea Kredit, Freedom30 is created to service home owners that wish to exploit the 'free equity' they have accumulated from increasing house prices during the last 8 to 9 years. He states that Nordea "is happy to present an extra flexibility and freedom to customers with free equity, so they can obtain a low interest rate and 30 years of interest-only payments" (Nordea, 2018).

According to André (2010), the most indebted American households played a key part in triggering the global financial crisis in 2009. Considering the relatively recent global crash and the negatively spiralling

effect of interest-only mortgages, it can seem troublesome that several banks recently started offering lending with even more lenient payment profiles. However, one could also argue that prolonging the period of interest-only payments of a mortgage will have limited effect on house prices in general. Within the first year of obtaining the loan the payment is identical whether the mortgage includes a 10 year or a 30-year interest-only period. According to *Dam et al.* (2011a), it was shown how the first-year loan payment affects the demand of housing in the short run and thus the price. As a result, 30-year interest only mortgages would presumably not increase demand in the short run. Moreover, it seems unlikely that the new loan type will receive equally widespread acceptance as the 10-year interest-rate only mortgages in 2003. The target customer of Freedom30 and other similar loans is considerably narrower compared to the 10-year interest-only.

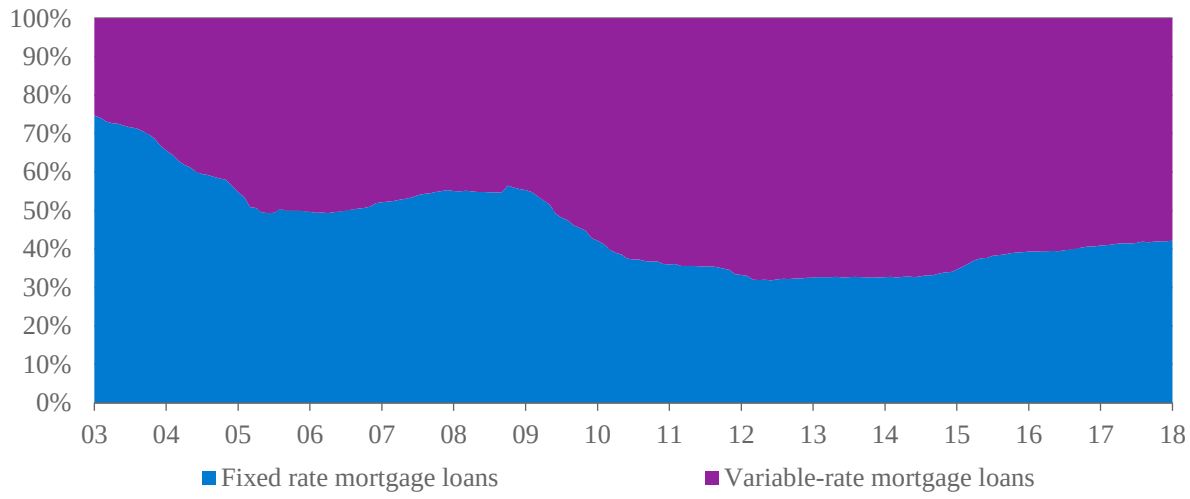
Firstly, new regulations introduced in Denmark will ensure a large proportion of the population are ineligible to obtain the mortgage. This is especially the case for the younger generation, who have yet to enter the house market due to the high price level, and will have to look for more lenient LTV-ratio loans. Evidently, young people and first-time home buyers in general are faced with greater barriers to enter the market for owner-occupied housing. In fact, the proportion of 25 to 29-year olds living in an owner-occupied dwelling in Denmark have been reduced to 28% in 2015 as opposed to 58% in the 1980's (Politiken, 2018b).

Secondly, the new loan products are expected to experience limited demand. Comparing the 30-year interest-only mortgages to the product innovation in the early 2000's, the latter was wildly popular and obtained by a diverse demographic, spreading across age groups and income levels (see figure 0-23). Presumably because a 10-year interest-only period is a more manageable time frame and can in some cases constitute a rational choice, typically for first time home buyers. Postponing repayments on a mortgage 10 years ahead in time can provide a necessary financial slack to young people while studying or being on maternity leave for example. From this point of view zero repayment profiles make sense economically. They allow the loan taker to enter the housing market and commence the repayment when he or she is established financially. However, gaining financial stability should in any case not take 30 years and indeed the motivation to obtain interest-only mortgages with this duration is presumably to free up liquidity to alternate consumption and or to ensure future affordability of a currently owned house. Therefore, the supposed loan takers are long-time home owners, looking to refinance their mortgages for the mentioned reasons. Thus, aiming the product towards senior citizens who are characterized by a relatively lower income that will want to reap a benefit from their gathered home equity from long-time ownership of an occupation.

Several other factors are relevant to look at when assessing the Danish mortgage credit market. In particular, we want to highlight how the widespread use of adjustable-rate mortgages caused many borrowers to follow

a short-term approach, meaning that adjustable-rate loans could seem to be more attractive to them than they actually were, especially when long-term interest turn out being significantly higher than short term interest rates. For, a steep yield curve is a good indication of this (*Dam et al.*, 2011a). The increased use of variable-mortgages in Denmark is highlighted in figure 0-24 below.

Figure 0-24 - The percentage of mortgages with a fixed rate or a variable-rate in Denmark



Source: Nationalbanken

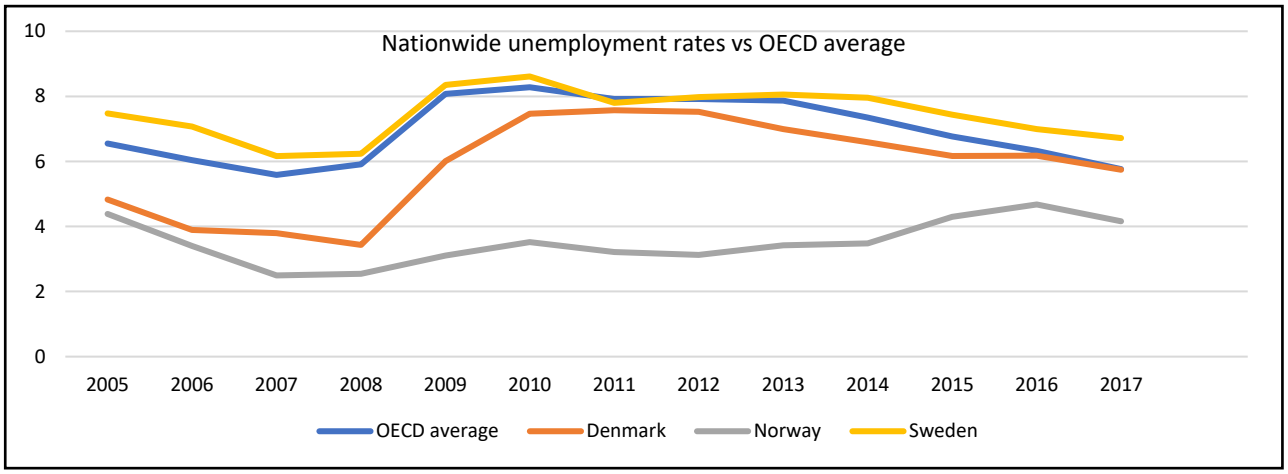
This can prove detrimental to cash-constrained individuals who might not be able to afford such an interest rate hike. For, these adjustable rate loans were coupled with deferred amortisation to form a unique but dicey mortgage instrument. Consequently, with both components bundled into the mortgage, early year payments ended up being a mere fraction of the long run yearly payments thanks to interest only payments and low variable short-term interest rates. This can seem attractive and lure individuals into obtaining this financing option but the short-lived benefits are soon eroded once the commencement to amortisation and higher

interest rates kicks in. This in turn can result in many households having to adjust their borrowing, consumption and investment.

7.3 Unemployment

The unemployment rate influences the demand and price of housing as it is related to households' expectations surrounding their future income. This affects households' ability to service debt and pay their mortgages, and in some cases can force home owners into selling if the unemployment persists. In Denmark and Norway, the unemployment rate has year on year been below the total OECD average since 2005[8], with an average yearly rate of 5.86% and 3.53% respectively from 2005-2017. Sweden's unemployment rate, on the other hand, has been vastly higher with an average yearly rate 7.45% over the same period. With this, the country has persistently ranked above the total OECD average for the past twelve years, with 2011 being the sole exception whereby its unemployment rate performed marginally better than the OECD average.

Figure 25 - National unemployment Rates of the three Nordic countries vs OECD average



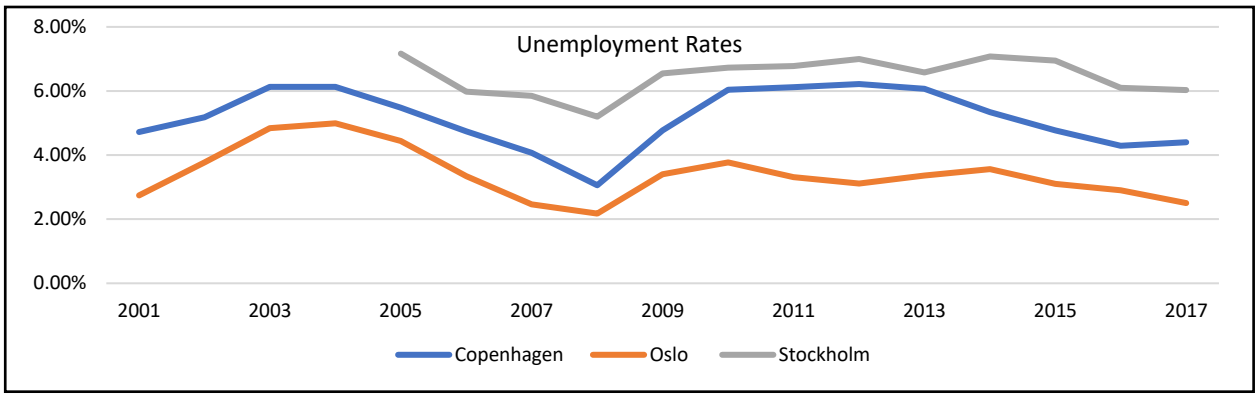
Source: OECD

The unemployment rate influences the size of the housing market. From the demand side, a low (high) unemployment rate contributes to expectations of high (low) future income and solvency. This impacts housing prices as when households expect their income to decrease (increase), they will be less (more) encouraged to enter into the property market and invest in housing, as their ability to serve the debt will be weakened (strengthened). From the supply side, higher (lower) unemployment rates will also make it more (less) difficult for sellers as homeowners will have a weakened (strengthened) tendency to move due to their increased (lessened) probability of being unemployed in the near future. As a result of this, when unemployment rates increase (decrease), there are both fewer (more) buyers and sellers (Gan *et al.*, 2018).

[8] The figures surrounding the total OECD average unemployment rate are only available from 2005-2017

Unemployment rates also tend to correspond with countries' business cycles as rates tend to be higher during recessions and lower during expansionary periods. Additionally, when the unemployment rate is higher, the credit constrictions becoming tighter and vice versa (Gan *et al*, 2018). For instance, the loan to value ratios were low during the Great Recession while they were high during the housing boom of the 2000s (Iacoviello & Pavan 2013, Corbae & Quintin 2015). The unemployment rate is thereby perceived to be a meaningful indicator for house price development and will be elaborated upon further in this section.

Figure 26 - National unemployment Rates of the three Nordic capitals



Source: DST, SSB & SCB

Figure 26 illustrates developments in the unemployment rate for Copenhagen, Stockholm and Oslo from 2001 until 2017[9]. Attaining city specific unemployment data adds great value to our analysis, as the rates can potentially deviate from their respective nationwide unemployment figures. When reviewing the data, we can see that Oslo has continuously had the lowest unemployment rates of the three cities, and Stockholm the highest, with Copenhagen bearing somewhat of a middle ground between the two. Perhaps what is most alarming in Stockholm's case, is the substantial gap between their own unemployment rate and Oslo's. Since 2005, when data was first published for the Stockholm market, Oslo's unemployment rate has more often than not been half the Stockholm rate. This is particularly surprising considering that the price development

[9] Unemployment data for Stockholm was only available on Statistics Sweden from 2005 onwards

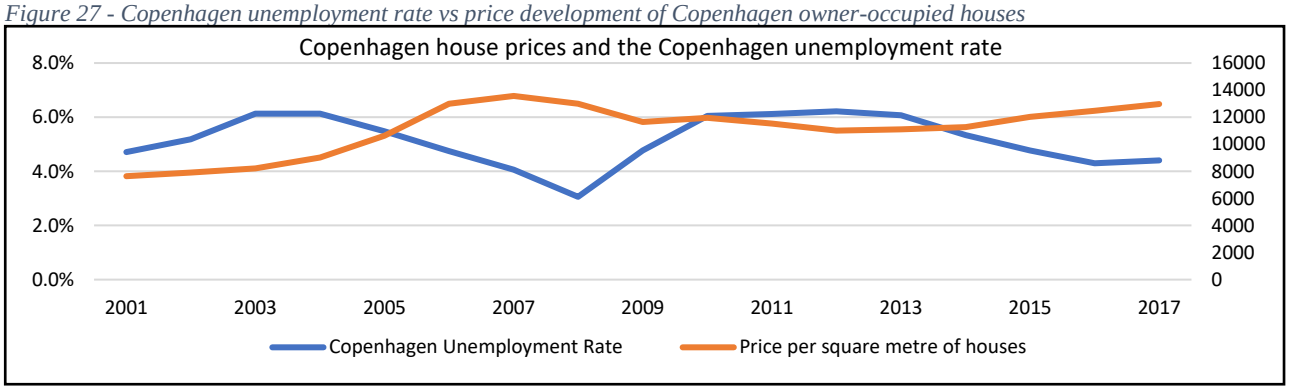
between the two cities has followed a similar trajectory during that timeframe.

7.3.1 Copenhagen

From figure 27, we can see that the unemployment rate in Copenhagen has generally been at a level between 3 and 6 percent since 2001. During this period, there have been rapid fluctuations in the rate, with large swings transpiring in the immediate years pre and post financial crisis, and in more recent times the rate witnessed a sharp drop from 2013 until 2016.

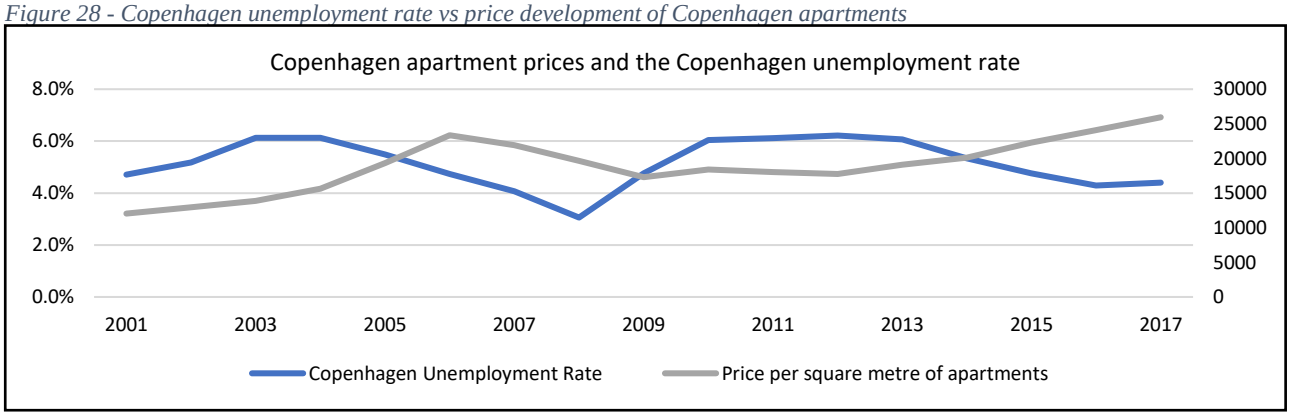
Firstly, in relation to the the years leading up to the financial crisis from 2003 until 2008, Copenhagen's unemployment rate almost halved, dropping from 6.1% to 3.1%. This coincided with the rapid development in house and apartment prices, with both increasing by more than 58 percent between 2003 and 2007. However, it should be pointed out that while the unemployment rate fell by 1% in the year that followed between 2007 and 2008, both house and apartment prices decreased by 4.2% and 10.3% in the same year, which signifies potential bubble tendencies prior to the crisis.

Figure 27 - Copenhagen unemployment rate vs price development of Copenhagen owner-occupied houses



Source: DST & Finance Denmark

Figure 28 - Copenhagen unemployment rate vs price development of Copenhagen apartments



Source: DST & Finance Denmark

In 2008, with the occurrence of the financial crisis, we started to see the adverse aftermath effects that it had on the economy as a whole with the unemployment rate spiralling upwards. For by 2011, the unemployment rate was now back at 2003's 6.1% level. This increase in unemployment to some extent corresponds with the decrease in housing prices over the same three-year spell with annual housing and apartment prices declining by 11.3% and 8.2% respectively. While this is somewhat sizable decrease in prices levels, one could argue prices could have expected to have fallen even further than they did, given that the unemployment rate almost doubled.

Between 2011 and 2013, the unemployment rate remained steady at a 6.1% to 6.3% level, while housing prices also remained relatively stable, deviating in value no more than 5.9% during this 24-month period. The stabilization of prices and unemployment was short lived, however, as both determinants started to fluctuate sharply yet again, this time from 2013 until 2016. Over this three-year span, the unemployment rate fell from 6.1% to 4.3%, while house prices increased by 12.3% and apartment prices appreciated by a hefty 26%. Lastly, it is important to note how between 2016 and 2017 the unemployment rate has begun to flatten with it increasing only marginally by 0.1%. Interestingly, both housing and apartment prices appreciated in value by 3.9% and 7.7% in the same timeframe which is somewhat worrying. If unemployment continues to stabilise for a prolonged period as we saw between 2010 and 2013, then one could anticipate that housing prices will follow suit as we witnessed beforehand.

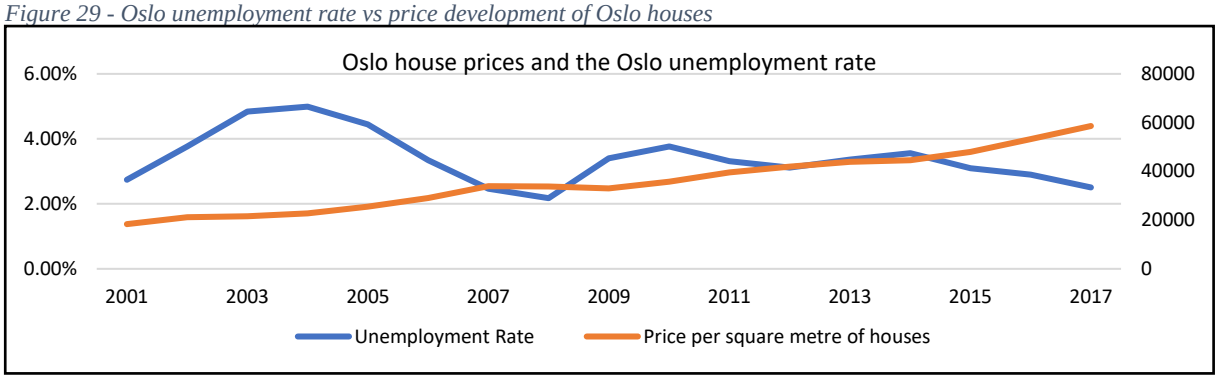
7.3.2 Oslo

As previously outlined, Oslo's price development has generally been on a steady upward curve since 2001. Its unemployment rate, in comparison has been generally low but also quite erratic. To begin with, between 2001 and 2004 the unemployment rate in Oslo rose from 2.74% to 4.99% as a result of low growth in the world economy and a decline in the competitiveness of the Norwegian industry (Eurofound, 2003). High labour costs in particular can be attributed to this, as the growth in real wages was strikingly higher than the growth in productivity (Norges Bank, 2003). As such, businesses needed to adjust their workforce in order to sustain profitability. Surprisingly, the prices of houses and apartments in Oslo increased by a hefty 24% and 27% respectively during the same three-year duration, indicating that the price growth was not supported by this fundamental factor.

Between 2004 and 2007, Norway like many other countries went through an expansionary period as the country experienced strong economic growth. During this time, the unemployment rate in Oslo more than halved, falling from 4.99% to 2.47%. This sharp drop in unemployment concurred with house price

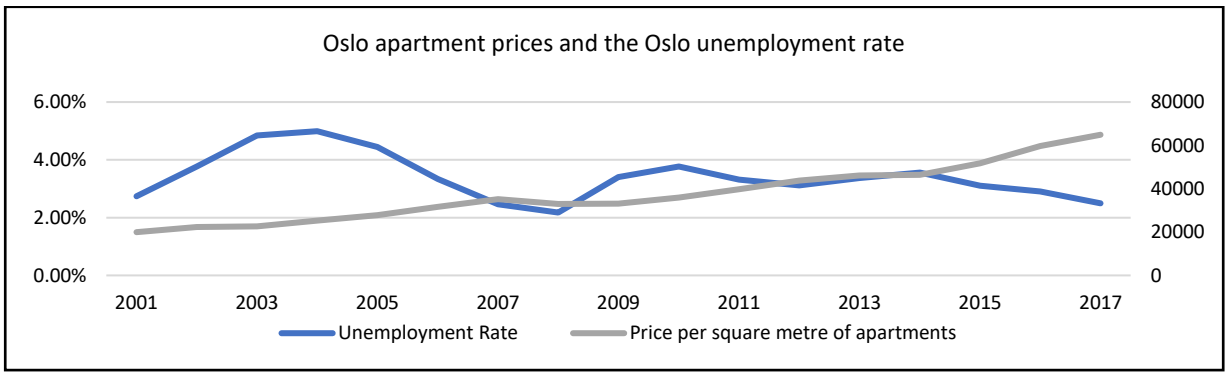
development, with house prices increasing by 49% and apartment prices increasing by 39%. By 2008, Oslo's unemployment level was at a record low level of 2.18%.

Figure 29 - Oslo unemployment rate vs price development of Oslo houses



Source: SSB & Alfred Berg Asset Management

Figure 30 - Oslo unemployment rate vs price development of Oslo apartments



Source: SSB & Alfred Berg Asset Management

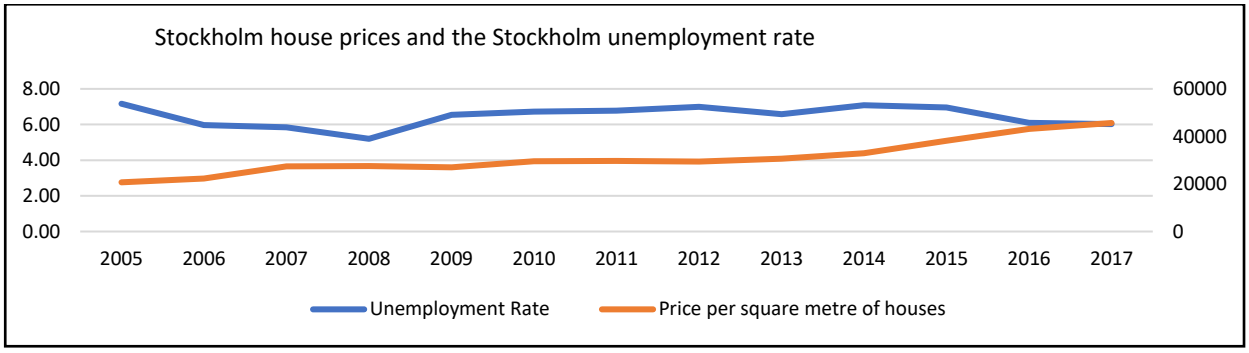
As aforementioned, the Financial Crisis was not as hard hitting for Norway and Sweden compared to its Danish counterpart. The increase in unemployment in Oslo as a result of it was short lived, reaching its post crisis peak of 3.77% in 2010. This "post crisis peak" rate was still lower than the 2005 rate, highlighting how successful Norway was in preserving job opportunities. House prices, remained at a stable level during the same two-year downturn, and only increased marginally in value. Following this between 2010 and 2014, the unemployment rate ebbed and flowed but remained at a low level between 3.12% - 3.56%. Oslo housing prices meanwhile recommenced their roaring growth as house and apartment prices witnessed 35% and 40% growth.

As per figure 29 & 30, since 2014 the underlying macroeconomic theory behind there being a negative relationship between house prices and unemployment has been exemplified. Year on year, the unemployment rate has declined while housing prices have increased. Unemployment has dropped from 3.56% to 2.50% while house and apartment prices experienced 32% and 40% gains. It is clear that over this three-year period in Oslo, price development can be supported by this fundamental factor.

7.3.3 Stockholm

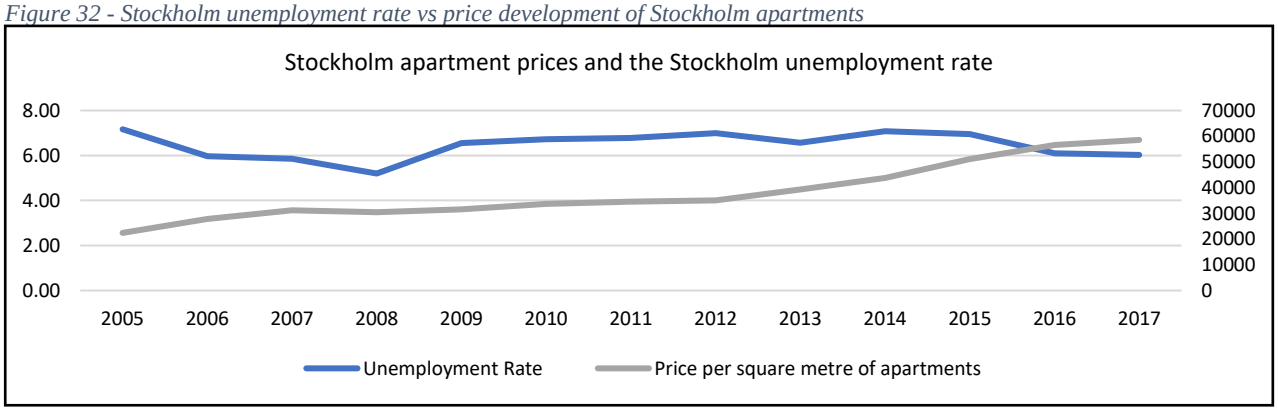
In relation to the Stockholm market, there is only data available on the city's unemployment rate from 2005 onwards. Nevertheless, we can still observe that the rate has remained at a high level over the past decade or so, with the only significant reduction in the rate occurring in the lead up to the Financial Crisis in 2008. From 2005 until 2008, the unemployment rate dropped from 7.17% to 5.20%, while housing and apartment prices experienced 33% and 36% gains. Following the crisis, the unemployment rate increased sharply from 5.20% to 6.55% between 2008 and 2009. Housing prices, on the other hand remained stable during the immediate one-year aftermath of the crisis, with house prices falling marginally by 2% and apartment prices increasing by 3.5%.

Figure 31 - Stockholm unemployment rate vs price development of Stockholm houses



Source: SCB & Alfred Berg Asset Management

Figure 32 - Stockholm unemployment rate vs price development of Stockholm apartments



Source: SCB & Alfred Berg Asset Management

In the subsequent years, the unemployment rate remained very stable, with the rate fluctuating between 6.55% and 6.95% from 2009 until 2015. The rate then decreased to some extent in 2016 from 6.95% to 6.10%, and has since remained stable once again, averaging 6.03% in 2017. In contrast to this, housing prices have witnessed spectacular growth, in particular from 2013 onwards. Prior to this, house and

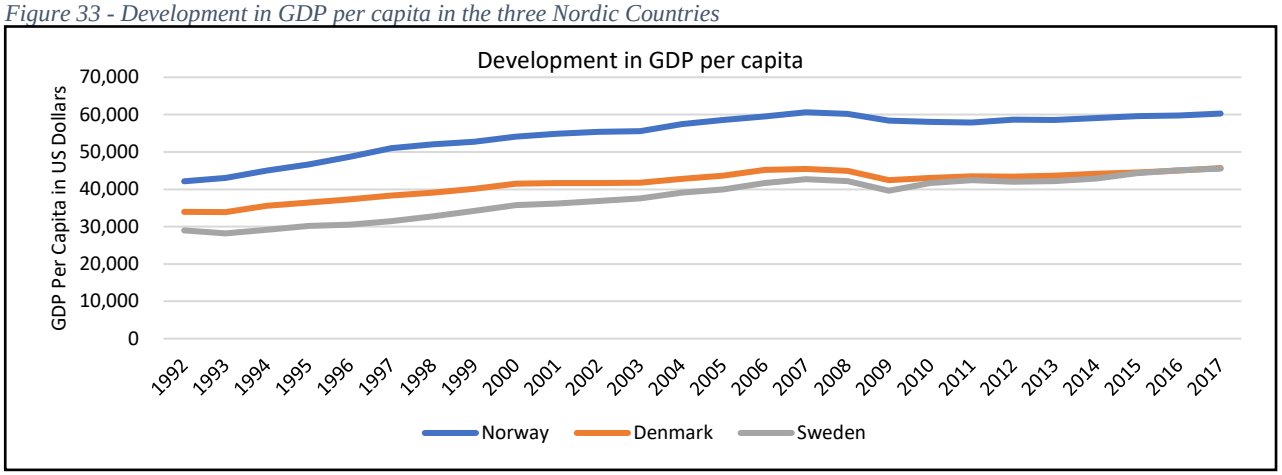
apartment prices increased by 9.6% and 6.6% in 2010 with the price level remaining steady in the subsequent two years. Thereafter, housing prices have frenzied, and by 2017 housing prices were now 55% higher than their 2012 level while apartment price increases were even more substantial, accumulating 67% price growth in a five-year spell. Accordingly, this pricing growth is evidently not supported by this fundamental factor, highlighting bubble tendencies in the Stockholm market.

Conclusively, in recent years the substantial drop in the unemployment rate in both Copenhagen and Oslo has supported their sizable price growth. Nonetheless, we have also identified the 2001 – 2004 period whereby the price levels in both cities were not supported by this fundamental factor. In comparison, Stockholm's unemployment, while demonstrating low volatility in the last decade, has showcased strong bubble tendencies. This is due to the fact that while its house prices have escalated considerably in recent years, its unemployment has failed to uphold this, continually remaining at a high and steady level above 6%.

7.4 Gross Domestic Product (GDP) Development

One of the key factors affecting the value of housing prices is the overall health of a country's economy itself. GDP is a primary indicator for this. GDP measures economic activity and production and has become the underlying benchmark of success and a dominant standard at the heart of the global economy (Adler *et al.*, 2016; Fioramonti, 2017). As house prices generally follow the cyclical development of their respective economies, it is beneficial to compare these two factors. GDP development thus exhibits significant predictive power over housing prices (Englund & Ioannides, 1997). The GDP figures, retrieved from the OECD's online database, are given on a national level per capita. They are measured in US dollars at current prices, making it easier to compare the development between the three countries. The GDP development for the three Nordic nations is presented in figure 33 below.

Figure 33 - Development in GDP per capita in the three Nordic Countries

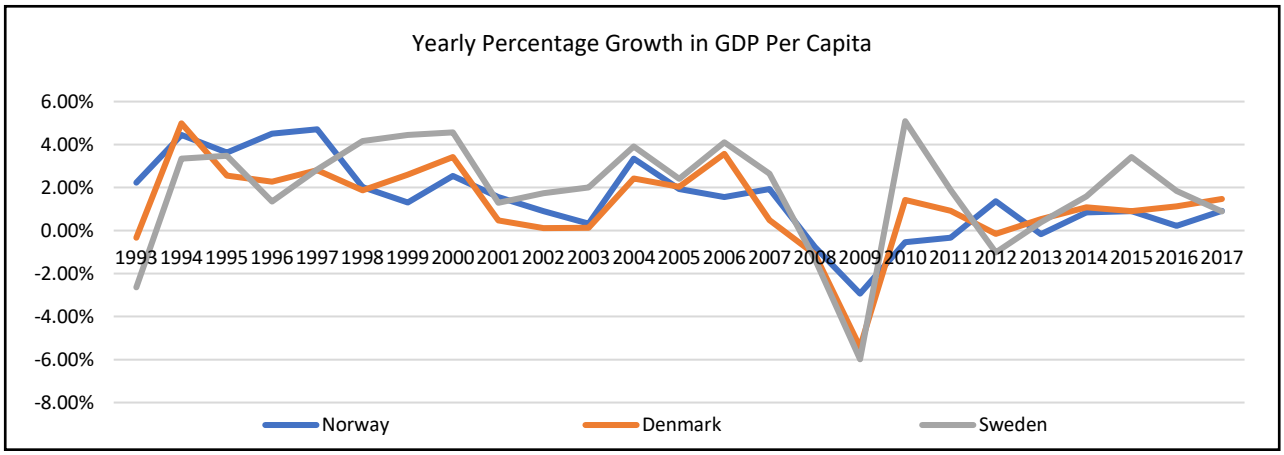


Source: OECD

As illustrated above, all three Nordic nations have had stable growth over the past 25 years, albeit there have been some years where declines in GDP have been experienced. As of 2017, GDP levels in Denmark and Sweden were at their highest levels to date, with Norway only narrowly trailing its 2007 peak. Norway's higher level of GDP per capita can be largely attributed to the high income derived from its petroleum sector, which over the years became a vital part of the Norwegian economy. To exemplify this, Norway was the third highest exporter of natural gas in the world in 2017, accommodating circa 25 per cent of the EU gas demand (Norwegian Petroleum, 2018). This high level of GDP in Norway can therefore go some way in explaining why price levels are higher in Oslo than both Copenhagen and Stockholm.

The yearly GDP growth is presented in figure 34 below. As we can see, the growth in GDP was positive in all three countries from 1994 all the way up until the Financial Crisis, with growth particularly strong between 1994 and 2000. With the occurrence of the financial crisis, GDP subsequently declined in both 2008 and 2009 in all three respective countries, with the slump more substantial in Denmark and Sweden. Norway in comparison had a lower fluctuation during the crisis, most likely due to its high oil revenues and reserves (Lin *et al.*, 2013).

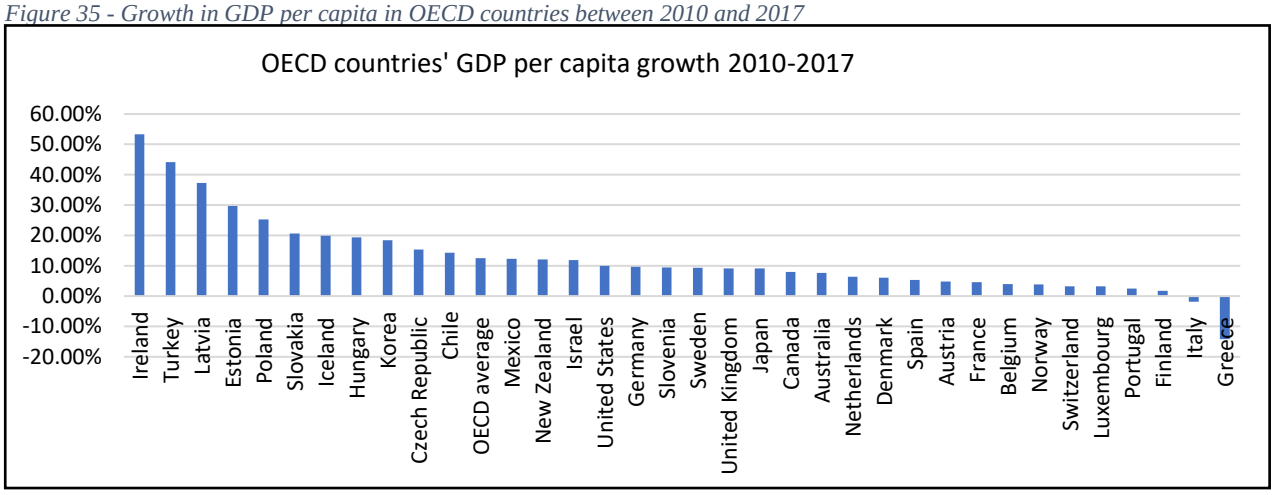
Figure 34 - : Yearly Percentage Growth in GDP per capita



Source: OECD

While housing prices have soared in all three cities since the Financial Crisis, the same cannot be said for the three countries' GDP growth when compared internationally. All three countries GDP growth (as shown in figure 35) ranked below the OECD average from the 2010 to 2017. This, together with the modest growth levels outlined above, suggest that this factor does not support the recent growth in housing prices in all three capital cities.

Figure 35 - Growth in GDP per capita in OECD countries between 2010 and 2017



Source: OECD

7.5 New Constructions

As previously outlined, the housing stock represents the number of housing units in the previous year plus the difference between new constructions and housing which has fallen out of the market (Hendry, 1984). The development of the housing stock within the three cities is an interesting aspect to review, as it will allow us to examine the expansion of the supply levels in recent years for each of the respective cities. In

theory, an increase (decrease) in the level of housing stock relative to demand for housing will lead to lower (higher) housing prices as there will be a reduced (increased) level of competition in the market.

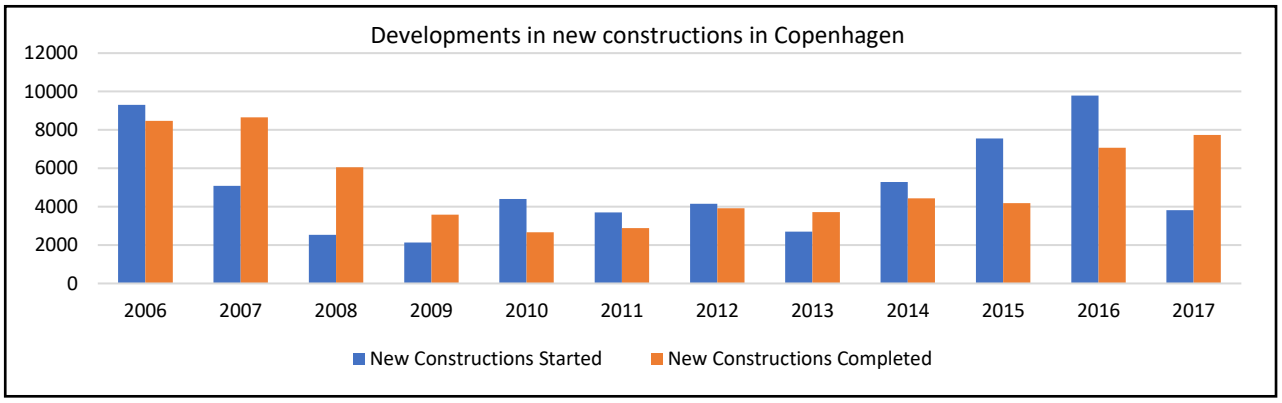
Our analysis will examine the yearly volumes for both new constructions started and for new constructions completed. We look at these two components because the construction of new houses is a lengthy process, which potentially can result in there being large discrepancies between each component yearly. Therefore, the annual growth in housing will depend significantly on the time taken to build new housing. We have been able to obtain city specific data for all three cities. For each city, the data is from 2006 onwards and was retrieved from DST (Copenhagen), SCB (Stockholm) and SSB (Oslo).

As of 2006, the number of new constructions started and new constructions completed in all three cities was at a very high level, with all three experiencing housing booms thanks to strong demand coupled with their respective strong economies. However, this was soon to come to an end as a consequence of the Financial Crisis and the subsequent crash in housing prices. This had a ripple effect as the uncertain economic conditions pushed down the number of houses being bought and sold, which meant that the number of new constructions being built witnessed a sharp decline. This was the case for all three Nordic cities in the subsequent three years after 2006, and Copenhagen suffered the biggest falls in newly started constructions as they dropped by 77% by 2009 compared to their 2006 figure. In comparison, Oslo and Stockholm suffered 74% and 67% falls respectively.

7.5.1 Copenhagen

In firstly reviewing the construction expansion within the Copenhagen market, we can see (as per figure 36) that the number of constructions started and completed reached their lowest points in 2009 and 2010 respectively. The number of new constructions, both completed and started, remained at reduced levels up until 2013. This can largely be attributed to sunken house prices during this spell, leading us to assume that the demand for new housing remained low, which in turn affected developers' incentive to build as it was less profitable.

Figure 36 - Developments in new constructions started and completed in Copenhagen



Source: DST

As the economy began to recover and pick up again, so too did the demand for housing and the construction sector. From 2014 to 2016, Copenhagen underwent a considerable phase of housing expansion whereby the number of new constructions built intensified. This peaked in 2016 when the number of started constructions stood at a towering 9,787 units, which was more than triple the 2013 level, and was notably above the pre-crisis 2006 level.

Despite this surge in expansion, the number of started new constructions more than halved in 2017 to 3,818 units. This is proof indicating that the construction sector has started to slow down, most likely due to the fact that the increased supply levels in prior years have now reduced the gap between supply and demand. Moreover, this increased supply coincides with the diminishing growth levels of housing prices in the last year.

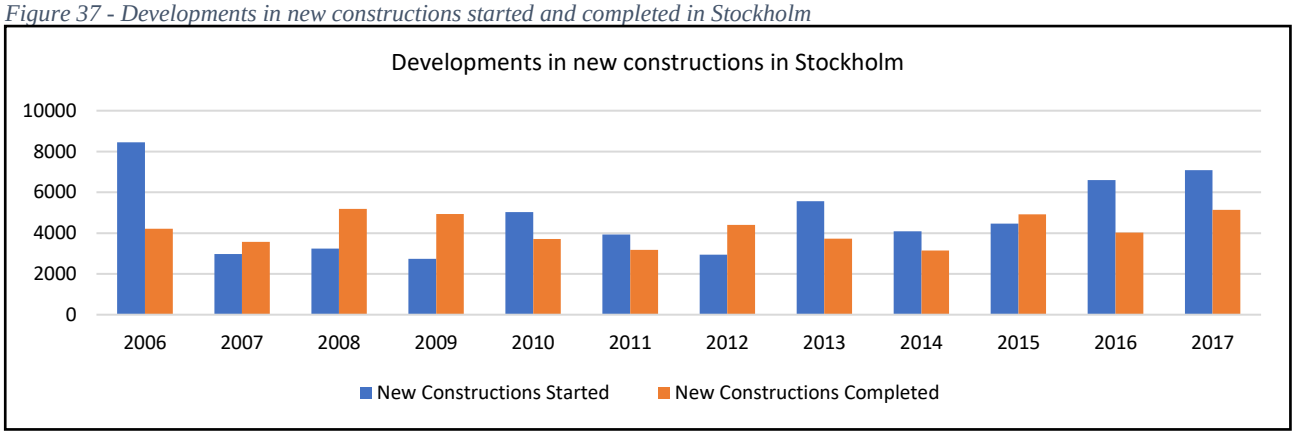
It is lastly important to point out that due to the lengthy process of construction and the time lag between the start and end of building projects, we may not be able to see the impact that the substantial reduction in started constructions has on the completed constructions volume until further down the line in 2018 and beyond.

7.5.2 Stockholm

Stockholm witnessed a steep fall in the number of started new constructions between 2006 and 2007. The volume declined by a staggering 65%, tumbling from 8,444 units to 2,966 units. Following this frantic twelve-month spell, we can see that the level of started constructions displayed high volatility in the subsequent years with 2010 and 2013 witnessing substantial hikes followed by considerable dips in the year following (as per figure 37). Meanwhile, the number of constructions completed remained rather steady up until 2014 with the exceptions being 2008 and 2009. As it can typically take from 2-4 years to complete a building project (including the planning), the high volumes in these two years can be largely attributed to the large-scale new constructions of 2006. Over the same timeframe, the annualised prices of Stockholm housing

had experienced six years of consecutive growth. This decrease in the level of new constructions completed suggests that the price growth was supported by this fundamental factor over this interval.

Figure 37 - Developments in new constructions started and completed in Stockholm



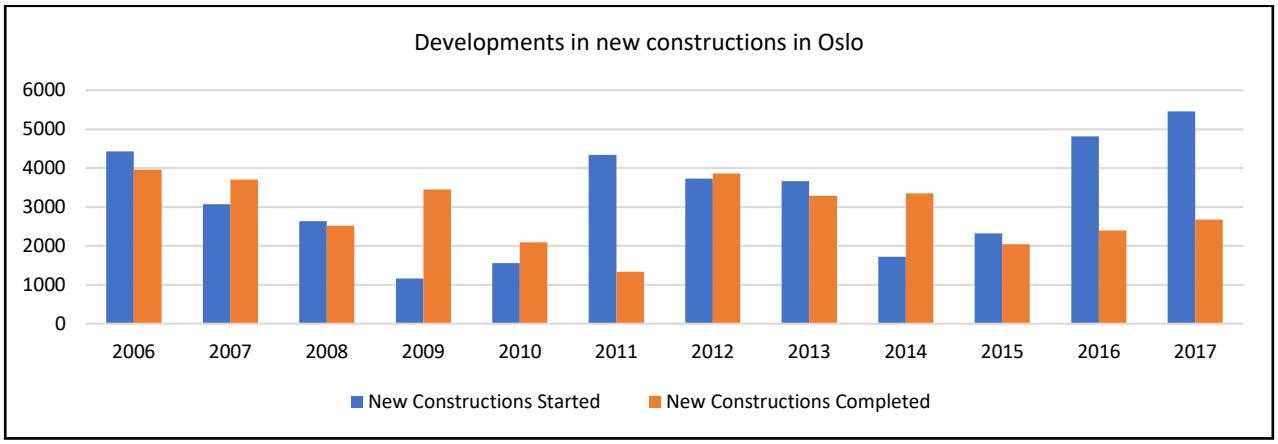
Source: SCB

Akin to the Copenhagen market, Stockholm has also witnessed an explosion in housing growth in recent years. From 2014 to 2017, Stockholm went through a period of tremendous housing expansions where the number of started constructions maintained four consecutive years of growth. In 2017, the number of new constructions in Stockholm was 7,084, which represented a 3,000 increase from the 2014 level. While completed constructions have shown an upward trajectory over the same period, this has a lagged effect on the level of completed constructions, and so we have not yet seen its full impact. Nonetheless, by 2017 the number of completed constructions were at their highest yearly level since 2008. The considerable growth in housing over the last three years would indicate that the price levels have not been supported by this fundamental factor.

7.5.3 Oslo

As per figure 38, alike the Stockholm and Copenhagen housing markets, the number of new constructions in Oslo followed a downward trend from 2006 to 2009, with the city also experiencing its lowest level in new constructions started in 2009. However, unlike the other two cities, the number of new constructions started quickly self-corrected itself, and by 2011 the number of new constructions started was now almost four times the 2009 figure and marginally below the 2006 level. Constructions started remained at a high level until 2013 and therein dropped by more than 50%. Again, similarly to the Copenhagen and Stockholm housing markets, Oslo has too experienced a surge in growth in started constructions, and by 2017 the figure stood at 5462, which was 22% more than the 2006 level. However, it should be again noted that due to the time lag between starting and completing a construction, we have not yet seen the recent figures eclipse the 2006 level for constructions completed. Overall, the developments in new constructions in Oslo has been relatively high, which suggests that this factor does not support the substantial increases in housing prices in Oslo.

Figure 38 - Developments in new constructions started and completed in Oslo



Source: Statistics Norway

7.6 Housing taxation

Taxation is a key regulatory mechanism that can be altered to govern market behaviour. The housing market is no exception, and advantageous, as well as disadvantageous taxation is applied to impact the development of house prices. There are numerous taxes that both directly and indirectly impact the holistic user cost of owning a house. The thesis will however delimit itself to focus on key taxation parameters that relates to homeownership. Namely, the tax rate on property value, the deductibility of interest on debt and the taxation of capital gains.

The taxation of housing tends to be based on theoretical taxable values that always will be lower than the real

market value of the dwelling. Thereby, it is interesting to examine the development of the tax cost in relation to house prices in order to gain a better understanding of how advantageous tax schemes have favoured house ownership. Thus, an analysis of effective housing taxes will follow.

7.6.1 Copenhagen

The subject area of house tax in Denmark has been thoroughly examined in relation to the recent house market crash and academics are arguing that the tax system has played a distorting and destabilizing role (Dam *et al*., 2011b & Andersen *et al.*, 2014). In more recent years, the theme has received increased attention from national media outlets in conjunction with examples of incompetence and faulty tax bills carried out by the Danish Tax authorities. The documented destabilizing impact of the Danish housing taxes coupled with the current relevancy of the topic, makes it an interesting subject to examine. As a consequence, the thesis will devote more attention to analyse the taxation of housing in Denmark, compared to the two other Scandinavian countries.

First, in order to gain a better understanding of the current housing taxation in Denmark and how it has developed historically, a brief description of the background for the current property is provided.

Secondly, based on historical data from several sources, the thesis will calculate effective property value tax rates for both one-family houses and owner-occupied flats, as well as an effective land tax rate.

Thirdly, the thesis will highlight recent challenges and criticism pointed towards the housing taxation. Afterwards a discussion of the perceived impact of the imminent new system for housing taxation is conducted.

7.6.1.1 History of housing taxation in Denmark

In Denmark, homeowners are subject to two types of taxes directly related to housing, namely property value tax and land tax.

The property value tax is dependable on the official valuation of the property and includes the land value and all buildings. Prior to a widespread reform in 2000, the property value tax was calculated on an imputed rent basis. The imputed rent of one's dwelling was added to the total taxable income of an individual, minus a standard deductible although no such reduction was given to owners of flats. The imputed rent was calculated as 2% of the taxable value, up to a progression limit from where a property tax rate of 6% kicked in (Olesen & Pedersen, 2006). The taxable value is determined by an official valuation performed by the Danish Tax Authorities, who is responsible for updating the valuations every second year.

In 2000, the housing tax based on the imputed rent was replaced by a property value tax of 1% of the public assessment value deducted by DKK1.200, corresponding to the taxable value of the previous standard deduction. Furthermore, several extraordinary deductions were applicable for senior citizens and dwellings bought before 1998 (DTA, 2018).

In 2002, a house tax freeze was introduced and locked the taxable value of the dwelling to the 2001 level nominally. This resulted in a nominal freeze of the property value tax, effectively meaning that individuals will pay property value tax based on the lowest of the following three values[10]:

The official property valuation as of January 1st 2001, with an additional 5% increase.

The official property valuation as of January 1st, 2002.

The official property valuation as of October 1st in the latest income year.

To maintain the house tax freeze, the progression limit was simultaneously frozen to the 2001 level with a 5% increase. The progression limit has a result nominally equalled DKK3.040.000 since 2002. If the lowest of the above three official valuation scenarios equals a value higher than the progression limit a property value tax of 3% is added to the excess property value (DTA, 2018).

According to Frank Wiborg, Officer employed in the Danish Tax Authorities estimate that for 95% of home owners the public property valuation from either 2001 or 2002 will apply as the relevant tax base for the property value tax.

In addition to the property value tax, home owners pay a land tax twice a year. The tax is determined and collected by the respective municipality, why differences in tax rates between municipalities are present. The tax rates lie in the interval between 1,6% and 3,4 %.

Although, the land tax rate is not confined by the tax freeze it is also impacted by the house tax freeze in 2001, as the tax is dependable on the taxable land value derived from the official valuation. The land value reflects the value of the property site in its undeveloped state.

As mentioned, the municipalities are free to set the going land tax rate, however the Danish Ministry of Finance imposes a cap on how much the taxable land value is allowed to increase on a year-on-year basis, the so-called regulation ratio. Thus, the taxable land value is not allowed to increase more than the regulation ratio and if the actual land value appreciates more, then the increase will have to be evened out over the coming years, again limited to the given regulation ratio. In 2016 and 2017 the regulation ratio for owner-occupied housing equalled zero, but in 2018 the ratio has been set to 6,5% (DTA, 2017).

[10] From e-mail correspondence with Frank Wiborg, Officer in The Property Assessment Agency

In recent years, land taxes are further complicated by the fact that the collection of land tax relies on public valuations that dates back to the income year of 2011. No further official valuations have been carried out due to an outright scandal revealed to the public in 2013. This will be elaborated in the section *The inaccuracy of official valuations.*

According to Olesen & Pedersen (2006) the collection lag together with the cap on increases effectively results in homeowners paying a lower land tax rate than the rate set by the municipality. An assertion the thesis will examine in the following subsection *Effective house tax rates.*

Lastly, there is no tax on wealth in Denmark and home sellers are not required to pay any direct taxes on profits made from selling an owner-occupied dwelling. In other words, the realization of capital from home ownership is tax-free.

In the light of the complex development and high degree of regulatory measures that have been imposed on the taxation of homeownership in Denmark, the thesis will argue that is particularly relevant to examine the actual development of house taxation. Therefore, in this section the paper will attempt to calculate effective house tax rates, i.e. the house tax paid in relation the market value of housing. This will illustrate the proportional cost the average homeowner has been prompted to pay in house taxes in relation to his or her housing wealth.

7.6.1.2 Effective property tax rate – Copenhagen

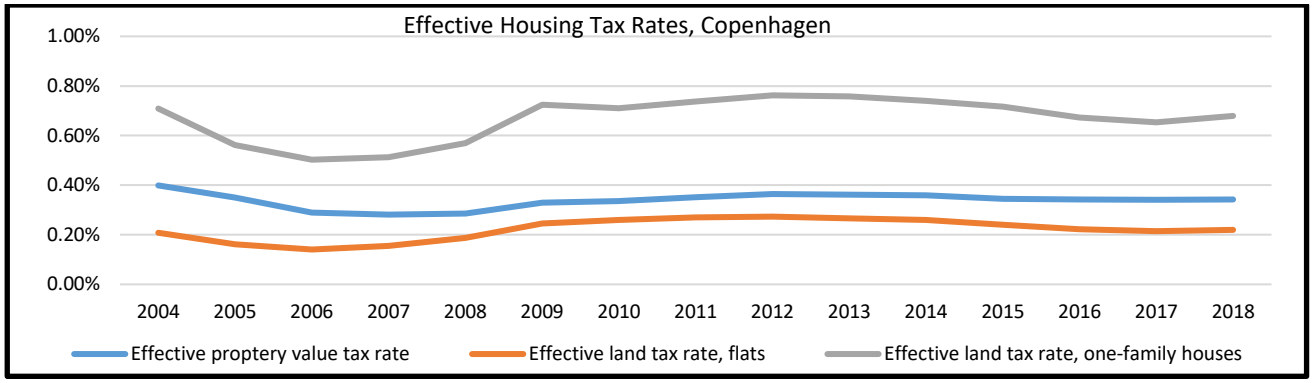
The analysis of effective house taxes in Denmark is inspired the approach adopted by the authors Olesen & Pedersen (2006). However, their analysis of regional effective house taxes relies on an extraordinary data output provided by DST, unfortunately unavailable to the public.

Ideally, the calculation of an effective property value tax should be derived from the tax revenue stemming from both one-family houses and flats. Furthermore, it would be useful to obtain revenue figures isolated from housing located in the thesis' consistent geographical definition of Copenhagen.

In reality, available data on revenue from property value tax does not distinguish between different types of dwellings and region of origin. As a result, the data also includes tax on commercial properties and holiday dwellings. In order to meaningfully isolate the property value tax stemming from the one-family houses and flats, the market value of the two types of dwellings located in Copenhagen are put in relation to total market value of all immovable property in Denmark. DST provides market values of different types of immovable property by region dating back to 2004 and with 2016 as the latest observation. The market values for 2017 and 2018 are forecasted by multiplying the price increase for flats in Copenhagen and the total market value of immovable property is forecasted using the GDP growth rates– See appendix 7.1 the effective property tax rates for Copenhagen.

By multiplying the market value share of flats in Copenhagen in relation to the total market share in Denmark with the total property value tax paid in each year the analysis has established a measure of the effective property value tax rate in the period of 2004 to 2018(Q2).

Figure 39 - The development of the Effective Housing Tax Rates in Copenhagen

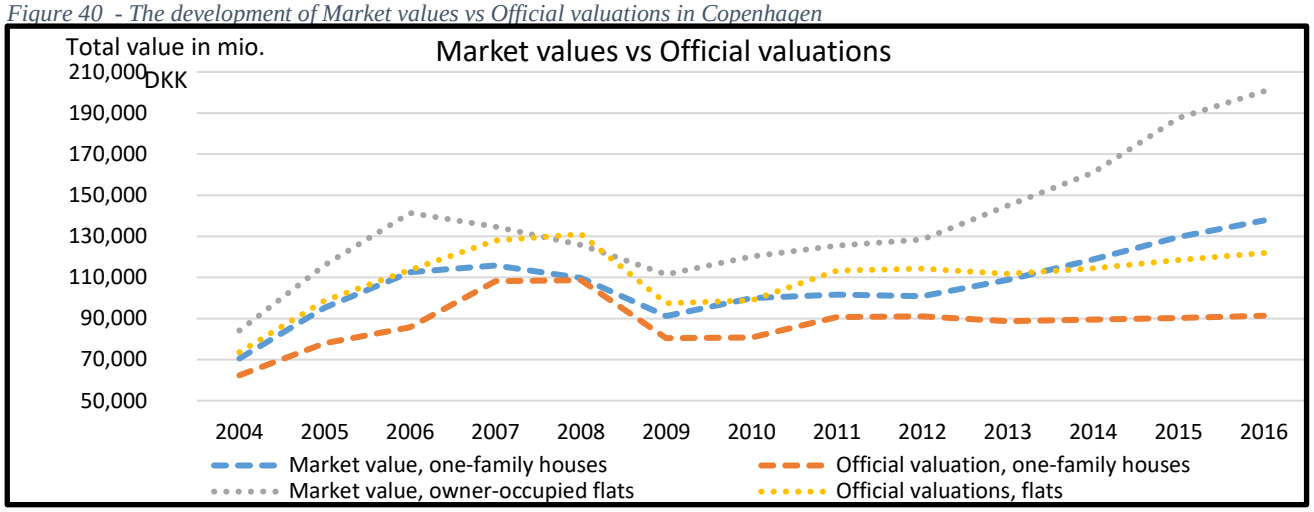


Sources: DST, Finans Danmark, The Danish Tax authorities, Nationalbanken and own calculations – see appendix 7.1

The effective value tax rate is applicable (i.e. identical) for both one-family houses and flats as the relative market value measure is included in the calculation hereof. The tax rate is plotted in figure 39 and lie in the interval of 0,28-0,40%. The effective rate should be considered in relation to the formal property value tax rate of (at least) 1%. The reason for the deviation is first and foremost because official valuations on an aggregated basis are lower than the market value. This is the case both for flats and one-family house and flats, and as the graphs in figure 40 illustrates the difference between market values and official valuations is increasing.

In an upward moving market for house prices a widening gap between the two measures is to be expected (Olesen & Pedersen, 2006). However, the gap is notably larger in recent years compared to the boom period leading up to the house market crash in 2007. The underlying reason is expectedly the collection lag of the official valuations that from 2013 and onwards are discontinued and instead follows the regulation ratio. Secondly, the effective property tax rate is expectedly lower than 1% due to various deductions mentioned in the previous section.

Figure 40 - The development of Market values vs Official valuations in Copenhagen



Source: DST (2018X) – see appendix 7.1

7.6.1.3 Effective land tax rate

Starting from 2007 up to and including 2018, DST and the Danish Tax Agency has collected and publicised data on the total land tax paid by type of dwelling and region. This statistic is particularly useful to the paper's analysis as the land tax rate varies between the four municipalities that comprise the thesis' geographical definition of Copenhagen.

The revenue from land tax is accordingly divided by the market value of the dwellings to remain consistent with the calculation of the effective property value tax.

For the years 2004-2006 the paid land tax is deduced by discounting the land tax in 2007 with the respective regulation ratios. Thus, the analysis assumes that all properties taxable land values rose with the highest allowed regulation ratio in 2006, 2005 and 2004. Arguably, this is a valid assumption as house prices soared in Copenhagen in that time period.

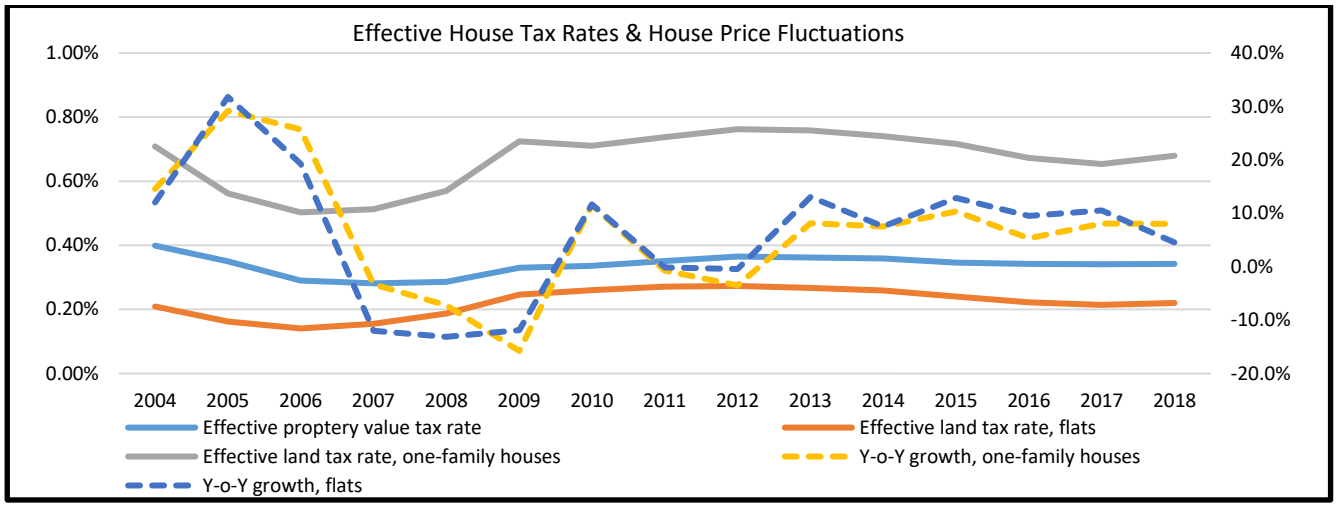
For 2018, the land tax revenue in 2017 is forecasted with a 4,8% increase which is the expected increase in the total national taxable land value given by DST (2017).

The effective land tax rates for one-family houses and flats are plotted in figure 41. From the graph, it is shown how the land tax rate for one-family houses are more volatile than the one for flats. Furthermore, the land tax comprises a larger relative amount of the market value for one-family houses than flats. Of course, one would expect this as one-family houses generally have a larger property area compared to flats and therefore a larger amount of the property value can be prescribed to the land value of the property in its undeveloped state.

Considering the volatile development of house prices in Copenhagen between 2004 and 2018, the effective tax rates seem follow a counterintuitive development. As other analyses of the subject have pointed out, ever

since the introduction of the house tax freeze in 2001, there have been a debt-bias in housing taxation in Denmark as taxation is decoupled from the development of housing prices (Smidova, 2016; Olesen & Pedersen, 2006 & Klein *et al*., 2016).

Figure 41 - The development in effective housing tax rates and the growth in house prices in Copenhagen



Sources: DST, Finans Danmark, The Danish Tax authorities, Denmarks National Bank and own calculations – see appendix 7.1

In figure 41, the year-on-year fluctuations on the average price per m2 for one-family houses and flats are plotted together with the development of effective house tax rates. From the graph, a major implication of the house tax freeze becomes evident as the two groups of graphs move in opposite direction. The relation entails that when house prices experience a real price increase the real effective house taxation decreases and vice versa.

Researchers have estimated the size of the lost stabilizing effect from the property tax freeze by calculating how much less house prices would assumingly fluctuate if effective housing taxes remained unchanged. Their simulation arrives at a reduction in price fluctuations of 22% and is based on the rate of price changes for one-family houses in the period 2002-2015, while assuming no changes in the housing stock (Klein et al., 2016).

Thus, house taxation no longer imposes an automatic dampening effect on house price fluctuations as it previously did before the introduction of the property value tax freeze and the cap on the appreciation of taxable land values. According to Andersen et al. (2014) destabilizing house taxation contributed to the bust of the Danish housing market as the taxation profile amplified the price increase. As previously mentioned, increasing house prices improved individuals' access to credit. Here the price increases reflect the increased

value derived from the property value tax savings that can be repurposed to service a higher debt (Klein et al., 2016).

The causality in key determinants of house price developments makes the housing market more vulnerable to future negative shocks when the real value of house taxation does not follow the level of house market values. This is exemplified in figure 41, as effective house tax rates rise when house prices declined in 2007-2009. Especially, the effective land tax rates rose in this bust period as the taxable land values had to catch up with soaring house prices of the boom period of 2004-2006. The official valuations were unable to encapsulate the price increase due to the cap, i.e. the land values experienced higher growth rates compared to the regulation ratios. As a direct result, the higher tax rates imposed a further negative impact on the already fast paced downward moving housing market (Klein et al., 2016).

Assuming that the taxable land value of given property rise along the imposed cap in every year since the introduction of the cap in 2002, the taxable land value in 2018 will correspond to the taxable land value in 2002 with 123,6% increase (DST, 2017). Comparatively, the average m2 price for one-family house and flats have respectfully increased 140,1% and 148,8% in Copenhagen in the same time period. The distribution of the total land tax paid in 2018 in Denmark reveals that the capital region accounts for 6,9 billion DKK out of 16,5 billion DKK, while the housing stock of owner-occupied dwellings in the region only accounts for 24,8% of the national stock (DST, 2018b).

The above analysis support existing academic literature deeming the house taxation in Denmark to have a destabilizing impact on house price development, effectively causing house prices to fluctuate more severely. In recent years, Copenhagen have once again experienced house price increases and effective house tax rates have once again dropped.

In summary, the analysis of effective housing tax has revealed that the tax basis for homeowner's property taxes deviates from the actual market values and as a result causes greater price fluctuations. The deviation is further supported by Frank Wiborg, who states that in 2013 it was merely 10% of Danish homeowners that paid land tax based on the latest public assessed land value. Thus, in 90% of all cases it will be a synthetically lower taxable land value that will apply in the actual taxation.

7.6.1.4 The inaccuracy of official valuations

In August 2013, an internal scandal within the Danish Tax Agency was revealed by an audit of the organisation performed by Rigsrevisionen. The audit concluded that the tax authorities in 2011 had conducted misleading property valuations in three out of four instances in terms of a discrepancy between the public valuation and the actual realized sales price. According to Rigsrevisionen, 41% of houses sold in the second half of 2011 were overvalued and in 34% of the cases the property were undervalued (Svare,

2018). The latter causing an incorrect lower tax bill and the former unfairly resulting in a higher tax bill to certain homeowners. Unsurprisingly, the revelation called for a reorganisation of the entire process behind the official valuations.

The 1st of July 2018 the Danish tax authorities, SKAT was split into seven separate agencies with a respective area of expertise and responsibility (see appendix x- org. chart). One of which, The Property Assessment Agency, was formed to create a new system for conducting valuations of private and commercial properties that are more transparent and precise compared to the former massively criticized system.

The revised system for property taxation has been underway since 2015 and initially projected to be completed in 2019, but the authorities have postponed completion several times and recently announced that the first batch of new official valuations are expected to be publicised in the second half-year of 2020 (Politiken, 2018c). The first batch however will include suggestive valuations in order to test the new system before it is fully enrolled. Hence, it is not until January 2021 that the new official valuations will have a taxable effect on individual's property taxation (Bolius, 2018).

7.6.1.5 How will the new tax reform affect housing taxation (and prices)?

The Property Assessment Agency have stipulated how certain dwellings and geographical regions supposedly will be affected by the new official valuations. According to the Danish Tax Authorities (DTA, 2017) 4 out of 10 homeowners will have a larger tax burden as a result of the new tax reform. It follows that individuals living in owner-occupied dwelling in Copenhagen are expected to receive the largest increase in their property taxes.

The formal property tax rates will most likely be reduced from their current level of 1% on property value and 2,6% on land value to 0,55% and 1,6% respectively[11] (Nordea Kredit, 2018). Furthermore, the former progression limit will be increased to DKK 7.500.000 from where a reduced property value tax rate of 1,4% will apply (DTA, 2017).

Until the new official valuations are publicised the authorities will await changing the rates. This leaves potential home buyers unsure when estimating the future ongoing financing cost of a dwelling. Overall, the effective property rates are expected to rise, despite the introduction of a precautionary principle that will reduce the taxable value of the new official valuations by 20%.

Specifically, the market for higher priced owner-occupied flats within Copenhagen will presumably bear the most negative impact from the new taxation system. Based on stylized calculations provided by the Property Assessment Agency, Nordea Kredit estimates that an owner-occupied flat in Copenhagen with a market

[11] The land tax is a national average as rates varies for each municipality

value in the interval of DKK 2.400.000 to DKK 5.000.000 is expected to drop 10% in market value as a direct response to the higher property taxes. Comparatively, a flat with a market value equal to DKK 1.300.000 will expectedly experience a 4% price drop. (Nordea Kredit, 2018). An analysis conducted by Realkredit Danmark (2018) also indicate that 'expensive' flats will experience a more negative impact from the new tax reform and estimates that flats priced at DKK 5.000.000 and DKK 9.100.000 will, all things equal, decrease in market value with 5% and 8% respectively. .

Owner-occupied flats and also one-family housing residing in Copenhagen are extra vulnerable to the impact of the new official valuations as these dwellings have experienced a larger price increase compared to other geographic regions since the house tax freeze. According to Las Olsen, Chief Economist at Danske Bank, the uncertainty and the prospect of rising property taxes will notably affect house prices during 2019 (Berlingske, 2018a). He asserts that owner-occupied flats in Copenhagen are particularly exposed as the publically assessed land values for those are relatively low. Since the cost of construction have been stable since the discontinuation of official valuations (the last being in 2011), the increase in house prices must be ascribed to increasing land values. This will indicate that for these dwellings the current deviation between the taxable property value and market value is salient. This is supported by the values for official valuations and market values in Copenhagen illustrated in figure 40.

For all individuals currently living in an owner-occupied dwelling or alternatively, taking ownership of such before 2021, will be eligible for a so-called 'skatterabat' (i.e. tax credit). If the new tax reform constitutes an increase in the property taxation of a given household, the subsidy ensures that homeowners will maintain their current tax burden until ownership of the dwelling changes (DTA, 2017).

The fact that policymakers are wavering from determining the specific tax rates could prove as a countermeasure for bubble tendencies formation. The empirical research by Case *et al.,* (2012) on the tax credit provided to home-buyers in the United States in 2009, caused increased activity and influenced a temporary turnaround of the housing market. The authors argue that a possible explanation for the increased activity from home-buyers is rooted in the psychological theory of regret. Individuals are prone to avoid the feeling of regret, sometimes to an unjustifiable extent compared to the actual loss (Loomis & Sugden, 1982). This regret aversion could be conducive to individuals taken on higher reservation prices for housing, if the upcoming tax credit in Denmark was more transparent than its current state. As mentioned, especially the tax burden of expensive flats in Copenhagen are expected to increase which mean homeowners of such a likely to receive a tax credit. If the tax credit was known with certainty it would, all things equal, drive prices upwards for this segment due to homebuyers' fear of missing out on the time restricted tax credit. On the other hand, the unknown factors of the new tax reform leaves room for individuals to discern future financing costs and the impact on housing prices. This is undesirable in terms of preventing bubble formation as it is a questionable assumption that individuals understand the real risk associated with homeownership.

Misconceptions as such can lead to irrational expectations about future prices. Thus, as the thesis have argued on several accounts, the presence of criteria for housing bubbles cannot be ruled out (Case & Shiller, 2004).

When the new official values are introduced it will entail that property taxes will follow the development of the house price in market values, hence the house tax freeze from 2001 and the property value tax stop will both be abolished. This will reinstate taxation's dampening effect on house price fluctuations which, all things being equal, must be characterized as a reasonable prudential measure for housing bubbles.

7.6.2 Stockholm

7.6.2.1 Effective property tax rates

In 1991, Sweden introduced a widespread tax reform so extensive authors have adopted it 'the tax reform of the Century' (Sørensen, 2010). Specifically, the property tax rate rose from 0,47% to 1,5% of the fair value of owner-occupied dwellings. Where the fair value should correspond to 75% of the market value of the dwelling (ibid). Similar to the public valuation process in Denmark, the Swedish Tax Agency preforms assessments of properties on a rolling schedule, although with a 6-year frequency. (STA, 2015)

The increased property tax was an attempt to neutralize the tax (dis)advantage between different types of asset classes and savings. However, in the years to come the property tax was progressively reduced and was not uniform between all types of dwellings.

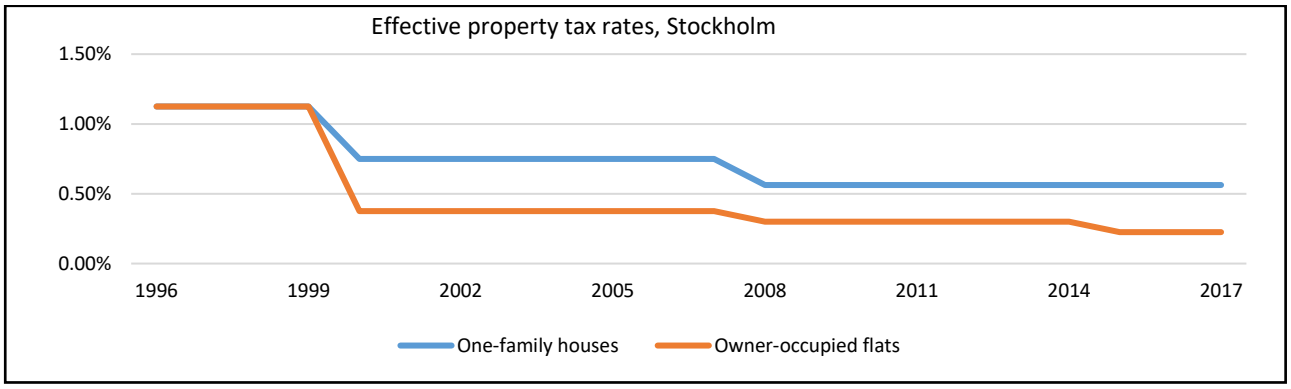
As from 2001, the property tax rate was respectively 1% and 0,5% for one-family houses and flats. In 2008, the government tax on immovable property was abolished and replaced by a significantly lower fixed municipal property tax. The fixed property tax was equal to SEK6.000 for houses and 1.200 SEK for apartments in 2008, however if the fixed charge is respectively lower than 0,75% and 0,4% of the assessed property value, the tax rates will apply. From 2015 and onward, the property tax rate for owner-occupied flats specifically was reduced to 0,3% (STA, 2015).

Additional reduction is rewarded to new dwellings in order to encourage construction. New dwellings are exempt from property taxes the first 5 years after completion and in the following 5 years, the occupant should only pay half the standard tax rate. (STA, 2008).

To simplify the calculation of the effective property taxes, the tax rates are included in the analysis as opposed to the fixed charges. Moreover, the tax advantage for new dwelling are not factored in the calculation of effective taxes.

The development of effective property taxes in Sweden are illustrated in figure 42.

Figure 42 - The development of the Effective Housing Tax Rates in Stockholm



Sources: Alfred Berg Asset Management and STA (2008 & 2015) – see appendix 7.2

7.6.2.2 Deductibility of interest expenses

With the reform in 1991 Swedish tax payers are able to deduct interest expenses at a marginal tax rate corresponding to 30% of the net negative capital income. However, when the interest paid exceeds 100.000 SEK only 70% of the expense is deductible against tax liabilities from other types of income. (Sørensen, 2010).

This progressive tax step is not taken into account in calculation of the fundamental P/I ratio for Stockholm and is moreover assumed to bear little effect to the results of the analysis.

7.6.2.3 Capital gains tax

In Sweden individuals are required to pay tax from their realized capital gain on residential property. Up to and including the year 2000 individuals was subject to pay tax on capital gains from the sale of an owner occupied dwelling corresponding to 15%[12] (STA, 2015). In 2001, the realized capital gain tax on residential property rose to 20% and rising again in 2008 to 22% in order to account for the declined property taxes that was now fixed at a nominal amount. (STA, 2008).

7.6.2.4 Housing wealth tax

Similar to Danish legislation, there is currently no tax on housing wealth in Sweden. The wealth tax was abolished in 2008 due to its distorting effect with varying tax rates on different assets types but also due to the fact it encouraged placement of capital outside of Sweden. Prior to the abolishment, a real estate wealth

[12] In practice, individuals are required to pay a 30% tax on half of the assessed profit.

tax of 1,5% was imposed on capital exceeding SEK 1.500.000 singles and twice the amount for couples. (STA, 2015).

The wealth tax imposed on individuals prior to 2008 is not factored into the fundamental P/I ratio for Stockholm.

7.6.3 Oslo

7.6.3.1 Effective property tax rate

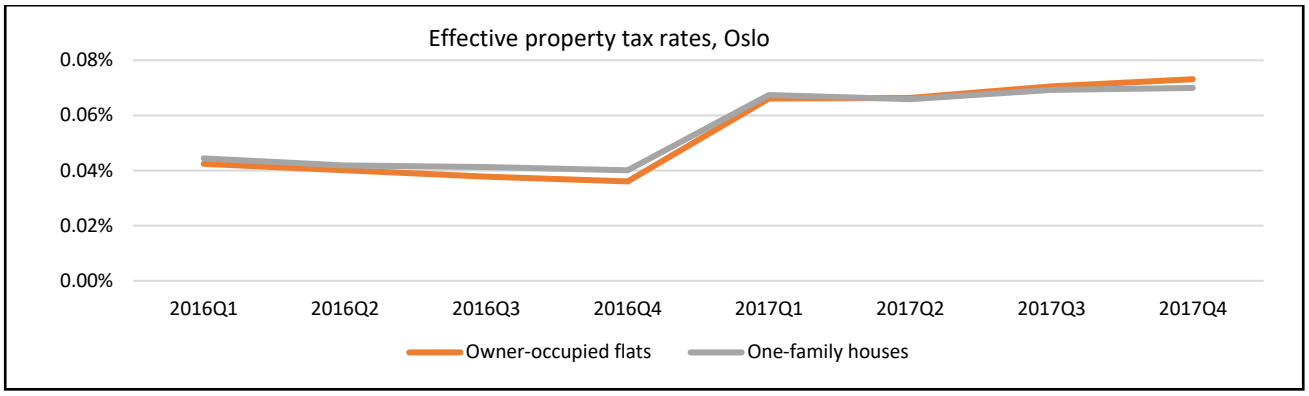
In Norway, property taxes are levied by the municipalities that can choose to impose a property tax on its owner-occupied habitants. In 2016, the Municipality of Oslo introduced a property tax rate of 0,2% and in 2017 the tax rate was raised to 0,3% of the taxable property value (News in English, 2017a). Prior to 2016, the was no property tax rate imposed on owner-occupied dwellings in Oslo.

The respective municipality can opt to use their own calculation method of determining the taxable property value or they can apply the Norwegian Tax Administration residential property values. The analysis of the effective property tax rate will assume the latter calculation method.

In practice, the residential property value is equal to the property value as of the latest wealth and income tax assessment, which is estimated by SSB. The taxable value is then 25% of the residential property value (NTA, 2018b). This means that there is a lag of 2 years between the applied property value and the property tax in a given year. Hence, the property tax bill in 2017 is calculated from the estimated market value of the property in 2015.

The effective property tax rates are illustrated in figure 43, shown for both flats and one-family houses, albeit the difference is minor between the two.

Figure 43 - The development of the Effective Housing Tax Rates in Oslo



Sources: Alfred Berg Asset Management, NTA and own calculations – see appendix 7.3

In the Municipality of Oslo, owner-occupied dwellings with a residential property lower than NOK 4.000.000 will be exempt from property tax. According to Anders Leisner, Head of the Judicial Department in Huseiernes Landsforbund, only 20-30% of the homeowners in Oslo was required to pay property tax in 2017 (IPTI Xtracts, 2017). The limited targeting of the property tax is accounted for by reducing the effective property tax rates by 30%, illustrated in figure 43. As the graphs show, the effect of the introduction of the property taxes in Oslo is minimal and therefore, the fundamental P/I ratio for Oslo does not include the effective property tax rate calculated in this section.

7.6.3.2 Housing wealth tax

Individuals are subject to pay both a state and a municipal wealth tax with marginal tax rate depending on their net wealth. For single tax payers, a wealth tax rate equal to 0,7% and 0,15%, respectively to the municipality and state, will be levied on capital in excess of NOK 1.500.000 in 2019. For the couples, the tax exemption limit is twice as high. (NTA, 2018c)

The housing capital is based on the taxable value of the dwelling corresponding to 25% of the residential property value. This creates an asymmetrical treatment of capital and therefor provides an incentive for individuals to place capital in real estate.

The tax exemption limit has increased steadily in recent years adding to advantageous treatment of housing as an investment option in comparison to other asset classes.

7.6.3.3 Capital gains

In Norway, individuals are exempt from paying tax on the profit from the sale of their property if certain requirements are met. All sales are subject to a direct transfer tax of 2,5%, a so-called stamp duty (Semler, 2016). However, this tax will be disregarded in the following empirical analysis of the price-to-income ratio. Specifically, the home seller will be exempt from paying a capital income tax if:

The sale of the property takes places or is agreed upon more than 1 year after the initial purchase, or any other type of cessation of ownership (NTA, 2018b)

and

Before the sale takes place, the seller must have occupied the dwelling as his or her own home for at least 1 year within the last 2 years (ibid.).

The above requirements are seemingly imposed to limit the attractiveness of the Norwegian housing market to dealers of other than owner-occupied dwellings and foreign investors.

In the empirical analysis, the thesis will assume that is no imposed tax on the expected capital gain from housing.

7.6.3 Summary, part conclusion

As described above, the housing taxation in all of the three Scandinavian countries have the similarity of levying property taxes from a taxable value basis that is lower than the real (expected) market value of the dwelling, making it favourable to invest in housing compared to other investments.

Interest on mortgage and other debt is deductible and treated similarly to loss produced by other financial assets such as stocks and bonds. The realised profit from a house is treated differently than profit realized from other financial assets, favouring housing as an investment option. The benefit is most evident in Denmark as no restrictions are imposed on capital gains being exempt from tax. In Norway, individuals are able to dodge tax on the profit from selling a house by adhering to two requirements. In Sweden, housing sales profit are not exempt from taxation in an attempt to symmetrically treat different types of investment. Nevertheless, is it still favourable to invest in housing due to the fact that the taxable value only constitutes half of the profit.

Conclusively, all of the examined countries tax schemes undoubtedly favour housing as an investment option, albeit to a varying degree. The regulatory mechanisms encourage individuals to a higher degree to consider a home purchase as an investment option. This particular characteristic is one of Case & Shiller's (2004) identified criteria for bubble formation. The house tax freeze introduced in Denmark in 2001

was to some extent conducive to the housing bubble in 2007 as it was concluded to have a destabilizing effect, especially in main urban areas as Copenhagen. The imminent new tax reform is an attempt to resolve this issue. In Sweden, property taxation has similarly been decoupled from house price since the introduction of a fixed property charge with the tax reform in 2008. Arguably, the property tax system in Sweden provides a stronger incentive for home ownership compared to system in Denmark. The reported revenue

from property taxes in 2015 in Denmark was equal to 2,6% of GDP and revenue in Sweden only accounted for 1,2% reflecting a considerable difference in the property tax burden (Gaál, 2017).

7.7 Conclusion of comparative fundamental factor analysis

The following table shows whether or not the analysed fundamental factors support the high growth of house prices in Copenhagen, Stockholm and Oslo.

Table 3 - Overview of findings from comparative fundamental factor analysis

Fundamental Factor	Copenhagen	Stockholm	Oslo
Interest Rate	Can support price growth	Can support price growth	Can support price growth
Credit Market	Can support price growth	Can support price growth	Can support price growth
Unemployment	Can support price growth	Bubble tendencies	Can support price growth
GDP	Bubble tendencies	Bubble tendencies	Bubble tendencies
New Constructions	Bubble tendencies	Bubble tendencies	Bubble tendencies
Housing Taxation	Can support price growth	Can support price growth	Can support price growth

By firstly looking at the interest rate development of the three Nordic countries, the developments of both the key policy rate and the interest rate for new housing loans can support the growth in housing prices. Substantial reductions in the key policy rates has been made by all three respective countries, as a result of the Financial Crisis of 2008, which in turn has had a knock-on effect in reducing the housing loan rates.

In relation to the credit market, the fact remains that Denmark, Sweden and Norway are three of the four highest indebted households in the OECD, with Denmark leading the way. The availability of credit has no doubt played some part in fuelling the price increases in all three capitals.

The unemployment rate for both Copenhagen and Oslo has remained low and has followed a downward trend since 2008. The unemployment rate for Stockholm, on the other hand has remained high but stable over time.

The GDP growth in all three countries does not support housing prices, with all three countries GDP growth ranking below the OECD average from the period 2010 to 2017.

With regards to new constructions, there has been strong growth in the development of new constructions in recent years for the three respective cities. It has been established that the growth in the supply of housing in recent years suggests bubble tendencies in the market. However, as demographic developments are outside

of this paper, this finding is limited.

Lastly, the taxation of property in all three countries has to date incentivized individuals to own housing, which is largely down to the taxation landscape for all three countries.

8. Conclusion

The purpose of this paper was to examine if there are indications of current housing price bubbles in each of the three Nordic capitals. The thesis' analysis was delimited to only consider owner-occupied dwellings and applied segregated housing price data for flats and houses. For Copenhagen, price data on one-family houses was included.

The purpose of the first part of dissertation was to provide the reader with an understanding of what a bubble is, and to establish what kind of bubble this paper was looking to identify. Formally, Stiglitz's (1990) definition of an asset price bubble was adopted. Empirical research conducted by Case & Shiller (2004) provided the thesis with seven criteria for housing price bubble formation, valid for further investigation when assessing housing markets. The identified criteria chiefly considered the psychological aspect of homeowners and homebuyers' behaviour. As a result, some of the criteria was not empirically tested for nor comparatively analysed, as this was beyond the scope of this paper.

The thesis ensured that the reader was given an introduction to the dynamics of supply and demand of housing markets, both in the long-term and short-term. The theoretical discussion highlighted the implications of the housing supply being fixed in the short-run.

Having provided the reader with an understanding of the underlying theoretical mechanisms of housing price development, the thesis continues with an historical development of real housing prices in each Nordic capital, as well as the respective national development. The three Scandinavian capitals illustrated a somewhat similar behaviour in housing prices prior to the Financial Crisis. In particular, Copenhagen expectedly demonstrated a more rapid growth during the well documented recent housing price bubble in Denmark. However, the post-crisis price developments should be considered in their entirety. Copenhagen was slower to recover and also experienced a modest price correction following the crisis. Comparatively, Stockholm experienced surging real houses prices shortly after the recession, but recently suffered a correction in mid-2017. Additionally, the housing price development of Oslo was more modest compared to the other two capitals.

In order to investigate the first sub-question of the thesis' problem statement, the thesis conducted empirical testing of the Nordic capital housing markets using the two traditional house pricing models; HP-filter and P/I-ratio. The latter model was further elaborated upon as it considered the development of the user cost of owning a dwelling and thus providing a more precise estimate of the development in housing affordably. Moreover, the fundamental P/I ratio was expanded to account for the specific effective tax burden imposed in each capital.

While the HP-filter output identified several occasions of under- and overvaluation of the respective housing markets, the significant limitations and biased nature of the model only provided the thesis with weak indications of bubble tendencies.

The extensive P/I ratio delivered the bulk of empirical analysis in the thesis and provided the dissertation with a stronger measure of identifying signs of housing price bubbles.

Specifically, the P/I ratio analysis of Copenhagen illustrated significant overvaluation during the Danish Housing market bubble, supporting the precision of the thesis' measure. Post-crisis deviations between the actual and fundamental P/I ratio indicates a prolonged period of undervaluation. The paper will argue this is due to abnormally low interest rates as well as the model's crude measure for expected capital gains. Although, the latter is notoriously difficult to estimate.

The fundamental P/I ratio for Stockholm indicated that soaring house prices from 2012, to some extent were supported by favourable changes in fundamentals. However, from 2015 a deviation between the fundamental and actual P/I ratio for flats indicated considerable overvaluation. This was in spite of the real house price correction in the second half of 2017.

The development of the actual and fundamental P/I ratio for Oslo, identified more occasions of undervaluation rather the opposite seemingly due to regulation from policymakers. From 2014, the analysis indicated a slight overvaluation but this was rejected following a real house price correction in mid-2017.

In recent observation for all of the three Nordic capitals, owner-occupied flats seemed to deviate more from its fundamental price compared to houses. This indicated other fundamentals impact on housing prices unaccounted for in the P/I framework.

Lastly, the dissertation embarked on an extensive comparative analysis of other explanatory factors for housing price development. The section included both analysis and discussion of country specific conditions and developments in the following fundamentals; interest rates, the credit market, unemployment, GDP, new constructions and housing taxation.

For Stockholm, the price growth seemed to be supported by interest rates, credit market and housing taxation. While unemployment, GDP and new constructions indicated bubble tendencies.

For Oslo, the price growth seemed to be supported by interest rates, credit market, unemployment and housing taxation. The development of GDP and new constructions indicated bubble tendencies.

For Copenhagen, the price growth seemed to be supported by the development of interest rates, credit market, unemployment and housing taxation. While the architecture of the latter was shown to increase fluctuations in housing price developments. Oppositely, development of GDP and new constructions indicated bubble tendencies.

Conclusively, through the empirical research, there was a strong indication that prices in Copenhagen are more overvalued in recent observations. However, the differences in the time period may implicate the results. Furthermore, through the comparative fundamental analysis, it was established that the Stockholm housing market replicates having the strongest bubble tendencies of the three cities.

References

Adler, M., Fleurbaey, M. & Schreyer, P. (2016) *"GDP"* in The Oxford Handbook of Well-Being and Public Policy, ch. 3, Oxford University Press.

Alfred Berg Asset Management (2018) *"The Nordic housing market: a slowdown, but no collapse"*

Accessed in March, 2018
https://investors-corner.bnpparibas-am.com/investment-themes/nordic-housing-market-slowdown-collapse/?fbclid=IwAR1z3a49QmY6XM9Bs_9HcSz25GaftiafkG4147cF3BQEy5aBnNUKS1TttBE

Allen, F. & Gale, D. (2007) *"Understanding Financial Crises"* Oxford University Press

Almeida, H., Campello, M. & Liu, C. (2006) *"The Financial Accelerator: Evidence from International Housing Markets" Review of Finance*, **10**, (3), 321-352

Andersen, A. L., Duus C., & Jensen, T. L. (2014) *"Household debt and consumption during the financial crisis: Evidence from Danish microdata"* Danmarks Nationalbank. Working Papers, No. 89.

Andersson, B., Corbo, V. & Löf, M. (2015) *"Why Has Inflation Been So Low?"* Sveriges Riksbank Economic Review 2015:3

André, C. (2010) *"A Bird's Eye View of OECD Housing Markets"*, OECD Economics Department Working Papers, No. 746, OECD Publishing, Paris.

André, C., Gil-Alana, L. A. & Gupta, R. (2014) "*Testing for persistence in housing price-to-income and price-to-rent ratios in 16 OECD countries",* Applied Economics, 46:18, 2127-2138

Arestis, P., & González, A., R. (2014) *"Bank credit and the housing market in OECD countries"* Journal of Post Keynesian Economics, 36(3), pp. 467-490.

BBC Capital (2016) *"The city with 20-year waiting lists for rental homes"* 18 May 2016

Accessed in October, 2018:
http://www.bbc.com/capital/story/20160517-this-is-one-city-where-youll-never-find-a-home

Bergman, M., Sillemann, B., T. & Sørensen, P., B. (2013) *"House Prices in Denmark and Sweden"* Conference on *Reform Capacity and Macroeconomic Performance in the Nordic Countries* at Copenhagen Business School, September 20-21 2013

Berlingske, (2018a) "*Her falder lejlighedspriserne mest i København"*

Accessed in July, 2018:
https://www.berlingske.dk/privatoekonomi/her-falder-lejlighedspriserne-mest-i-koebenhavn

Bloomberg (2018a) *"Households in Denmark Can Lock in Mortgage Rates of 1.5% for 30 Years"*

Accessed in July, 2018:

https://www.bloomberg.com/news/articles/2018-01-08/extreme-rates-test-record-in-world-s-biggest-covered-bond-market?fbclid=IwAR3eEALxA47-yS4QxpQQmfyiu1sCjLMaO7ly-NtifyaEN0VQu_a-yMQwZt8

Bloomberg (2018b) *"Norwegian Housing Slump Deepens in Threat to Economic Recovery"*

Accessed in June, 2018:
https://www.bloomberg.com/news/articles/2018-01-04/norwegian-housing-slump-deepens-in-threat-to-economic-recovery

Bodie, Z., Kane, A. & Marcus, A., J. *"Investments"* McGraw Hill Education, 10th edition

Bolius (2018) *"Nye ejendomsvurderinger udskudt igen"*

Accessed in December, 2018:
https://www.bolius.dk/nye-ejendomsvurderinger-udskudt-igen-47524/

Boligmani (2015) *"Eier du ikke innen 30? Bare legg deg ned og dø"*

Accessed in December, 2018:
http://www.boligmani.no/aktuelt/kommentar/eier-du-ikke-innen-30-bare-legg-deg-ned-og-do/14007

Borio, C. & Lowe, P. (2004) *"Securing Sustainable Price Stability: Should Credit Come Back From the Wilderness?"* Monetary and Economic Department, BIS Working Papers No. 157

Borio, C., E., Kennedy, N. & Prowse, S., D. (1994) *"Exploring Aggregate Asset Fluctuations Across Countries: Measurement, Determinants and Monetary Policy Implications"* Bank of International Settlements (Basel), Monetary and Economic Department

Business Insider Nordic (2017) *"Swedish homeowners are sitting on a ticking bomb – that could blow up the economy"*

Accessed in December, 2018:
https://nordic.businessinsider.com/swedish-homeowners-are-sitting-on-a-ticking-bomb--that-could-blow-up-the-economy-2017-11/

Børsen (2018) *"Boligejernes drømmelån lukker efter nye rentefald"* Penge, July 19 2018

Accessed in December, 2018:
https://penge.borsen.dk/artikel/1/365453/boligejernes_droemmelaan_lukker_efter_nye_rentefald_det_er_utroligt.html?fbclid=IwAR0kK3qdLjSQavpdkRQs71EvHdOhzfGxNpjXlk5gEg9yWbHAouw52M5r5H0

Case, K. E., & Shiller, R. J. (1988) *"The behavior of home buyers in boom and post-boom markets"* No 890, Cowles Foundation Discussion Papers, Cowles Foundation for Research in Economics, Yale University

Case, K., E. & Shiller R., J. (2004) *"Is There a Bubble in the Housing Market?"* Cowles Foundation for Research in Economics, Yale University, Paper no. 1089

Case, K., E., Shiller R., J & Thompson, A. (2012) *"What Have They Been Thinking? Home Buyer Behavior in Hot and Cold Markets"* National Bureau of Economic Research, Working Paper 18400

CGFS (2012) *"Operationalising the Selection and Applications of Macroprudential Instruments"* CGFS Papers, No 48.

Chandler, D. & Disney, R. (2014) *"Measuring House Prices: A Comparison of Different Indices"* Institute for Fiscal Studies, London

Cho, M. (1996), *"House Price Dynamics: A Survey of Theoretical and Empirical Issues*", Journal of Housing Research, Vol. 7, Issue 2.

Christensen, I., Meh, C. & Moran, K. (2011) *"Bank Leverage Regulation and Macroeconomic Dynamics"* Bank of Canada, Working Paper 2011-32

Corbae, D. & Quintin, E. (2015) *"Leverage and the foreclosure crisis"* J. Polit. Econ., 123 (1), pp. 1-65

Crowe, C., Dell'Ariccia, G., Igan, D. & Rabanal, P. (2011) *"How to Deal with Real Estate Booms—Lessons from country experiences"* IMF Working Paper WP/11/91.

DST (2017a) *"Denmark in Figures 2017"*

Accessed in July, 2018:
https://www.dst.dk/Site/Dst/Udgivelser/GetPubFile.aspx?id=21501&sid=denmark%20in%20figures%202017%20net&fbclid=IwAR324dAlfuIMBZ7YTk6-VAe3bqOMpaYf_rnDDAnwQ75xNVxIYHFnwVgtkHE

Dam, N. A., Hvolbøl, T. S., Pedersen, E. T., Sørensen, P. B. & Thamsborg, S. H. (2011a) *"Developments in the Market for Owner- Occupied Housing in Recent Years – Can House Prices be Explained?"* Danmarks Nationalbank, Monetary Review 1st Quarter 2011, Part 2

Dam, N. A., Hvolbøl, T. S. &. Sørensen, P. B. (2011b) *"Can House-Price Fluctuations be Dampened*?" Danmarks Nationalbank, Monetary Review 1st Quarter 2011, Part 2

DiPasquale, D. & Wheaton, W., C. *"Urban Economics and Real Estate Markets"* Prentice Hall, 1996.

DST (2017) *"Ejendomsbeskatningen 2017 og 2018 - Nationalregnskab og offentlige finanser"* 23. November 2017, Nr. 452

DST (2018a) *"EU-harmoniseret forbrugerprisindeks oktober 2018 – Priser og forbrug"* Nyt fra Danmarks Statistik, 21. November 2018, nr. 438

DST (2018b) *"Ejendomsbeskatningen 2018 og 2019 - Nationalregnskab og offentlige finanser"* 22. November 2018, Nr. 440

DST (2018c) *"Consumer Confidence Indicator by Time"*

Accessed in December, 2018:
https://www.statistikbanken.dk/statbank5a/SelectVarVal/Define.asp?Maintable=FORV1&PLanguage=1

DTA (2017) *"Grundværdiregulering"*

Accessed in December, 2018:
https://www.skm.dk/skattetal/satser/kommunal-beskatning/grundvaerdiregulering-reguleringsprocenten-for-2018

DTA (2018) *"Ejendomsværdiskatteregler - en historisk oversigt"*

Accessed in December, 2018:
https://www.skm.dk/skattetal/statistik/tidsserieoversigter/ejendomsvaerdiskatteregler-en-historisk-oversigt

ECB (2016) *"Transmission Mechanism of Monetary Policy"*

Accessed in November, 2018:
https://www.ecb.europa.eu/mopo/intro/transmission/html/index.en.html

Englund, P. & Ioannides, Y. (1997) *"House Price Dynamics: An International Empirical Perspective"* Journal of Housing Economics, 6, (2), pp. 119-136

Eurofound (2003) *"Unemployment Rises"*

Accessed in December, 2018:
https://www.eurofound.europa.eu/observatories/eurwork/articles/unemployment-rises

Farelius, D. & Billborn, J. (2016) *"Macroprudential policy in the Nordic- Baltic area"* Riksbank, Penning- och Valutapolitik 2016:1

Ferrero, A. (2015) *"House price booms, current account deficits, and low interest rates"* Journal of Money, Credit and Banking, 47(S1), pp. 261-293.

Fioramonti, L. (2017) *"The world after GDP: Economics, politics and international relations in the post-growth era"* Cambridge: Polity Press.

Gaál, N. (2017) *"Nordic Heat Wave: Recent Housing Market Developments in Denmark and Sweden"* European Commission, Economic Brief 031, December 2017

Gan, L., Wang, P. & Zhang, Q. (2018) *"Market thickness and the impact of unemployment on housing market outcomes"* Journal of Monetary Economics, Vol. 98 pp. 27-49

Girouard, N., Kennedy, M., van den Noord, P. & André, C. (2006) *"Recent House Price Developments: The Role of Fundamentals"*, OECD Economics Department Working Papers, No. 475

Goodhart, C. & Hofmann, B. (2008) *"House Prices, Money, Credit, and the Macroeconomy"* Oxford Review of Economic Policy 24(1):180-205

Gordon, M., J. & Shapiro, E. (1956) *"Capital Equipment Analysis: The Required Rate of Profit"* Management Science, 1956, vol. 3, issue 1, 102-110

Green, R., K. & Wachter, S., M. (2007) "The Housing Finance Revolution" U of Penn, Inst for Law & Econ Research Paper No. pp. 09-37

Gryber, J., Jensen, A. & Kleven, H. (2017) "*Do People Respond to the Mortgage Interest Deduction? Quasi-Experimental Evidence From Denmark"* Working Paper 236000, National Bureau of Economic Research, Cambridge MA

Grytten O., H., (2009), "*Boligkrakk og finanskrise i historisk perspektiv"* Samfunnsøkonomen nr. 4 2009, 63 edition

Grytten, O., H. & Hunnes, A. (2014) *"An Anatomy of the Financial Crises in Norway, 1830-2010"* Financial History Review 21.1. pp. 25-57

Gyourko, J., Mayer, C. & Sinai, T. (2004), *"Superstar Cities"* Columbia Business School and Wharton School working paper

Hendershott, P. H. & Slemrod, J. (1982). "*Taxes and the User Cost of Capital for Owner-Occupied Housing"* AREUEA Journal, Winter, 10 (4), 375-393.

Hendry, D., F. (1984) *"Econometric Modelling of House Prices in the United Kingdom*" Ch. 8 in Econometrics and Quantitative Economics, Ltd., Oxford

Himmelberg, C., Mayer, C. & Sinai, T. (2005) *"Assessing House Prices: Bubbles, Fundamentals and Misperceptions"* National Bureau of Economic Research, Working paper 11643

Hodrick, R. & Prescott E., C. (1997), *"Postwar U.S. Business Cycles: An Empirical Investigation",* Journal of Money, Credit, and Banking, 29 (1), 1-16

Hoenig, T., M. (2008) *"Perspectives on the Recent Financial Market Turmoil"* Remarks at the 2008 Institute of International Finance Membership Meeting, Rio de Janeiro, Brazil, March 5.

Hviid, S., J. (2017) *"A Leading Indicator of House-Price Bubbles"* Danmarks Nationalbank, Working Papers, No. 114.

Iacoviello, M. & Pavan, M. (2013) *"Housing and debt over the life cycle and over the business cycle"* J. Monet. Econ., 60 (2) (2013), pp. 221-238

IMF (2014) *"Denmark – Selected Issues"* IMF Country Report No. 14/332, December 2014

IMF (2016) *"Norway – 2016 Article IV Consultation" "* IMF Country Report No. 16/214, July 2016

IMF (2018) "*What is the Central Bank policy rate?"*

Accessed May 2018:
http://datahelp.imf.org/knowledgebase/articles/484375-what-is-the-central-bank-policy-rate?fbclid=IwAR0RLCJXbdNol_W9WHGVbfkFUcbrLogUSa-_eU4zt1l6Qj6hyNjX6LoL9yo

Information (2018) *"Nye stramme låneregler bremser salget af lejligheder"*

Accessed November 2018:
http://woview.infomedia.dk.escweb.lib.cbs.dk/?url=https://www.information.dk/telegram/2018/09/nye-stramme-laaneregler-bremser-salget-lejligheder&OpointData=83c04fd0a38153fa9118e9256ab44a71JmlkX3NpdGU9MzQ4JmlkX2FydGljbGU9MzMyMzg4JmlkX3VzZXI9Mjg0MCZpZF9hcHBsaWNhdGlvbj0xMDAwMzU5Jmxhbmc9ZW4=

IPTI Xtracts (2017) *"Norway – April 2017"*

Accessed December, 2018:
http://www.ipti.org/wp-content/uploads/2015/09/IPTI-Xtracts-Norway-April-2017.pdf

Jacobsen, D., H. & Naug, B., E. (2005).*"What drives house prices"* Norges Bank. Economic Bulletin, 76(1), 29.

Jurgilas, M. & Lansing, K. (2012), Housing bubbles and homeownership returns" FRBSF Economic Letter,

Kalecki, M. (1976) *"The Problem of Financing Economic Development"* Essays on Developing Economies, Harvester Press, 1976.

Kaplan, G., Mitman, K., & Violante, G. (2017) "*The Housing Boom and Bust: Model Meets Evidence"* University of Chicago

Klein, A., Juul, S., Hvolbøl, T. S., Kramp, P., L. & Pedersen, E., H. (2016) *"House Price Bubbles and the Advantages of Stabilising Housing Taxation"* Danmarks Nationalbank, Monetary Review 3rd Quarter 2016

Krainer, J. (2003) "*House Price Bubbles"* FRBSF Economic Letter, Number 2003-06

Landvoigt, T. (2017) *"Housing demand during the boom: The Role of Expectations and Credit Constraint".* The Review of Financial Studies 30 (6), pp. 1865-1902.

Lamont, O. & Stein, J., C. (1999) *"Leverage and House-Price Dynamics in U.S. Cities"* RAND Journal of Economics 30 (3): pp. 498-514.

Lim, C., Columba, F., Costa, A., Kongsamut, P., Otani, A., Saiyid, M., Wezel, T. & Wu, X. (2011) *"Macroprudential Policy: What Instruments and How to Use Them?"* IMF Working Paper WP/11/238.

Lin, C., Y., Y., Edvinsson, L., Chen, J. & Beding, T. (2013) *"National intellectual capital and the financial crisis in Denmark, Finland, Iceland, Norway, and Sweden"* Springer Science & Business Media

Loomis, G. & Sugden, R. (1982) "*Regret Theory: An Alternative Theory of Rational Choice under Uncertainty."* Economic Journal 92, pp. 805–24.

McKinsey & Company (2015) *"The Construction Productivity Imperative"*

Accessed May 2018:
https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/the-construction-productivity-imperative

Miles, D. and V. Pillonca (2008), *"Financial Innovation and European Housing and Mortgage Markets"* Oxford Review of Economic Policy, Vol. 24, No. 1, 2008, pp.145–175

Miller, M., H. & Modigliani, F. (1961) *"Dividend Policy, Growth, and the Valuation of Shares"* The Journal of Business, Vol. 34, No. 4, pp. 411-433

Minsky, H., P. (1970) *"Financial Stability Revisited: The Economics of Disaster"* Federal Reserve Bank of St. Louis

Minsky, H., P. (1977) *"The Financial Instability Hypothesis: An Interpretation of Keynes and an Alternative to 'Standard Theory'"* Nebraska Journal of Economics and Business

Muellbauer, J. (2012) *"When is a Housing Market Overheated Enough to Threaten Stability?"* Property Market and Financial Stability, Reserve Bank of Australia, Sydney, pp. 73-105

Muellbauer J. & Murphy, A. (2008) *"Housing markets and the economy: the assessment" Oxford Review of Economic Policy*, 24, (1), pp. 1-33

Municipality of Copenhagen (2018) *"Analyse af Tilgængeligheden på Boligmarkedet I København"* Økonomiforvaltningen Notat, Sagsnr. 2017-0014221

Nationalbanken (2007) *"Recent Economic and Monetary Trends"* Danmarks Nationalbank, Monetary Review, 2nd Quarter 2007

Nationalbanken (2015a) *"Financial Stability 2nd half 2015"* Danmarks Nationalbank

Nationalbanken (2015b) *"2008 – Finanskrise og Sikring af Finansiel Stabilitet"*

Accessed June 2018:
http://www.nationalbanken.dk/da/om_nationalbanken/historie/Sider/2008---Finanskrise-og-sikring-af-finansiel-stabilitet.aspx

Nationalbanken (2017) *"Monetary and Exchange-Rate Policy"*

Accessed June 2018:
http://www.nationalbanken.dk/en/monetarypolicy/implementation/Pages/Default.aspx

Neytendasamtökin (2005) *"Mortgage Credit Markets in Iceland and Other European Countries"* The Consumers Association of Iceland.

Nissen, K. G., Pedersen, M. H., Rasmussen, M. H., & Thomsen, C. R. (2013) *"Prices of Flats in Northern European Capitals"* Danmarks Nationalbank, Monetary Review 3rd Quarter 2013, Part 1

News in English (2017a) *"Property tax bills skyrocket in Oslo"*

Accessed June 2018:
https://www.newsinenglish.no/2017/02/27/property-tax-bills-skyrocket-in-oslo/

Nordea (2018) *"Nordea lancerer boliglån med 30 års afdragsfrihed"*

Accessed December 2018:
https://www.nordea.com/da/press-and-news/nyheder-og-pressemeddelelser/press-releases-denmark/2018/2018-03-21-nordea-boliglaan-30-aars-afdragsfrihed.html

Nordea Kredit (2018) *"Disse boligkøbere bør vogte sig for de nye boligskatter"*

Accessed December 2018:
https://nordeakreditbolignyt.nordea.dk/artikler/201811-disse-boligkobere-bor-vogte-sig-de-nye-boligskatter

Nordea Markets (2017) *"Nordic Housing Bubble?"* Nordea Bank.

Accessed September 2018:
https://nordeamarkets.com/wp-content/uploads/2017/04/Nordea-On-Your-Mind_270317.pdf

Norge Bank (2003) *"The economic situation in Norway and abroad"* Speech

Accessed December 2018:
https://www.norges-bank.no/en/Published/Speeches/2003/2003-03-27/

Norges Bank (2018) *"Monetary Policy Report – With Financial Stability Assesment"*

Accessed September 2018:
https://static.norgesbank.no/contentassets/4a558ba8828547af8b2620f144331250/mpr_1_18.pdf?v=04/10/2018095219&ft=.pdf

Norwegian Petroleum (2018) *"Exports of Oil and Gas"*

Accessed December 2018:
https://www.norskpetroleum.no/en/production-and-exports/exports-of-oil-and-gas/

NTA (2018a) *"What is property tax?"*

Accessed June 2018:
https://www.skatteetaten.no/en/person/taxes/get-the-taxes-right/property-and-belongings/houses-property-and-plots-of-land/property-tax/what-is-property-tax/

NTA (2018b) *"Tax rules – Selling your own home"*

Accessed June 2018:
https://www.skatteetaten.no/en/person/taxes/get-the-taxes-right/property-and-belongings/houses-property-and-plots-of-land/sale/sale-of-your-own-home/tax-rules/

NTA (2018c) *"Wealth tax"*

Accessed June 2018:
https://www.skatteetaten.no/en/rates/wealth-tax/

OECD (2018) *"Marriage and Divorce Rates"*

Accessed June 2018:
https://www.oecd.org/els/family/SF_3_1_Marriage_and_divorce_rates.pdf

OECD Data, 2018 *"Household Disposable Income"*

Accessed December 2018:
https://data.oecd.org/hha/household-disposable-income.htm#indicator-chart

OECD iLibrary (2018) *"Consumer Prices"*

Accessed December 2018:
https://www.oecd-ilibrary.org/economics/data/prices/consumer-prices-complete-database_0f2e8000-en

OECD.Stat (2018) *"Quarterly National Accounts: Quarterly Growth Rates of Real GDP, Change Over Previous Quarter"*

Accessed December 2018:
https://stats.oecd.org/index.aspx?queryid=350

Olesen, J. O. & Pedersen, E. H. (2006) *"Housing Stock and Housing Tax in a Regional Perspective"* Monetary Review 3rd Quarter 2006

Oust, A. (2018) *"The End of Oslo's Rent Control: Impact on Rent level"* Economics Bulletin, Volume 38, Issue 1, pp. 443-458

Politiken (2018a) *"Forældrene bliver hængende i store huse"*

Accessed December 2018:
https://politiken.dk/forbrugogliv/forbrug/art6640882/Forældre-bliver-hængende-i-store-huse

Politiken (2018b) *"Unge får sværere ved at overhale forældrenes levestandard"*

Accessed December 2018:
https://politiken.dk/indland/art6637433/Unge-får-sværere-ved-at-overhale-forældrenes-levestandard

Politiken (2018c) *"Nye vurderinger af 2,2 millioner ejendomme står på usikker grund"*

Accessed December 2018:
https://politiken.dk/indland/art6933398/Nye-vurderinger-af-22-millioner-ejendomme-står-på-usikker-grund

Poterba, J. M. (1992) *"Taxation and Housing: Old Questions, New Answers"* The American Economic Review, Vol. 82 No. 2 pp. 237-242.

Realkredit Danmark (2018) *"The Copenhagen Housing Market – The Current Status and Risk"*

Accessed November, 2018:
https://www.rd.dk/PDF/Investor/Library/Presentations%20and%20analyses/The%20Copenhagen%20Housing%20Market.pdf?fbclid=IwAR1z3a49QmY6XM9Bs_9HcSz25GaftiafkG4147cF3BQEy5aBnNUKS1TttBE

Reinhart, C., M. & Rogoff, K., S. (2009) *"This Time Is Different, Eight Centuries of Financial Folly"* Princeton University Press.

Riksbank (2018a) *"Swedish Market (based) rates, Government Bonds"*

Accessed in November, 2018:
https://www.riksbank.se/en-gb/statistics/search-interest--exchange-rates/

Riksbank (2018b) *"The Inflation Target"*

Accessed in September, 2018:
https://www.riksbank.se/en-gb/monetary-policy/the-inflation-target/

Riksbank (2018c) "Repo rate, deposit and lending rate"

Accessed in September, 2018:
https://www.riksbank.se/en-gb/statistics/search-interest--exchange-rates/repo-rate-deposit-and-lending-rate/

Romer, C., D. (1999) *"Changes in Business Cycles: Evidence and Explanations*" Journal of Economic Perspectives, Vol. 13, No. 2, pp. 23–44

Røed Larsen, E. (2005). *"Boligprisens Utvikling."* SSB, økonomiske analyser, 5/2005

Semler (2016) *"Introduction to do Real Estate in Norway"*

Accessed in December, 2018:
https://www.selmer.no/read/introduction-to-real-estate-transactions-in-norway

Shiller, R. (2006) *"Long-Term Perspectives on the Current Boom in Home Prices"* Economists' Voice, The Berkeley Electronic Press.

Shiller, R., J. (2007) *"Understanding recent trends in house prices and home ownership"* No. w13553, National Bureau of Economic Research.

Shleifer, A. (2000) *"Clarendon Lectures: Inefficient Markets"* Oxford University Press.

Smidova, Z. (2016) *"Betting the House in Denmark"* OECD, Economics Department Working Papers, No. 1337

Spange, M. (2010) *"Can Crises Be Predicted"* Nationalbanken, Monetary Review 2nd Quarter Review

Spange, M. & Toftdahl, M., W. (2014) *"Fixed Exchange Rate Policy in Denmark"* Danmarks Nationalbank, Monetary Review 1st Quarter 2014

Stiglitz, J., E. (1990) *"Symposium on Bubbles"* The Jounal of Economic Perspectives, Vol. 4, No. 2, pp. 13-18

SSB (2013) *"Statistical Yearbook of Norway - Table 454"*

Accessed in September, 2018:
https://www.ssb.no/a/english/aarbok/tab/tab-454.html

SSB (2018a) *"Norwegian economy boosted by increase in petroleum investment"* National Accounts and Business Cycles

Accessed in September, 2018:
https://www.ssb.no/en/nasjonalregnskap-og-konjunkturer/artikler-og-publikasjoner/norwegian-economy-boosted-by-increase-in-petroleum-investment

SSB (2018b) *"Interest Rates in Banks and Mortgage Companies"* StatBank 10746

Accessed in September, 2018:
https://www.ssb.no/en/statbank/table/10746/

STA (2008) *"Taxes in Sweden - An English Summary of Tax Statistical Yearbook of Sweden"* Swedish Tax Agency

STA (2015) *"Taxes in Sweden - An English Summary of Tax Statistical Yearbook of Sweden"* Swedish Tax Agency

Svare, O. (2018) *"SKAT – From One to Seven"* Written exam, form course: Managing Strategy Implementation in the Modern Corporation, taught at Copenhagen Business School

Sørensen, Peter B. (2010) *"Swedish Tax Policy: Recent Trends and Future Challenges"* Expert Group on Public Economies 2010:4, Ministry of Finance

The Balance, (2018) *"What Was the Bank Bailout Bill"*

Accessed in September, 2018:
https://www.thebalance.com/what-was-the-bank-bailout-bill-3305675

The Riksbank, 2018
https://www.riksbank.se/en-gb/monetary-policy/the-inflation-target/

The Economist (2015) *"Space and the City"*

Accessed in May, 2018:
https://www.economist.com/news/leaders/21647614-poor-land-use-worlds-greatest-cities-carries-huge-cost-space-and-city

Tsatsaronis, K. & Zhu, H. (2004) *"What drives housing price dynamics: Crosscountry evidence"* BIS Quarterly Review, March 2004

Wachter, S., M. (2016) *"Credit Supply and Housing Prices in National and Local Markets"* Public Finance Review, 44(1), pp. 6-21.
Wong, E., & Tsang, A. (2016) *"How does loan-to-value policy strengthen resilience of banks to property price shocks—evidence from Hong Kong"* International Real Estate Review, 19(1), pp. 120-149.

Zan, Y. & Wang, S., T. (2012) *"Permanent and transitory shocks in owner-occupied housing: A common trend model of price dynamics"* Journal of Housing Economics, Volume 21, Issue 4, December 2012, Pages 336-346, ISSN 1051- 1377

Østrup, F. (2016)*"Dansk Økonomi Trues af et Skrantende Svensk Boligmarked"* 13 November 2016, Jyllands-Posten

Østrup, F. (2017) *"Synspunkter om Realkredit"* December 1 2017, OmFinans, Aalborg

Østrup, F., Oxelheim, L. & Wihlborg, C. (2009) *"Origins and Resolution of Financial Crises: Lessons from the Current and Northern European Crises"* Asian Economic Papers 8:3

Appendices

Abbreviations

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