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Housing Affordability

Leverage and Risk

Master Thesis

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Executive Summary

The housing affordability area covers a large scope as it deals with two different aspects of the topic, the definition from endless sources from the literature and the measurement of the defined subjects.

In this thesis the two affordability measurements chosen and defined, the purchase affordability and the repayment affordability, will be explained and used in a sensitivity analysis made on different mortgage types chosen from the Danish mortgage loan market. The strongly related parameters when considering affordability, leverage and risk, will be discussed and it will be demonstrated that those parameters are extremely important when discussing housing affordability. The relationship between those factors is complicated and double sided as it at the same time can indicate increased and decreased affordability. The additional costs and benefits of homeownership must be taken into concern when analyzing the concept of housing affordability. Taxes and user cost will therefore be discussed as they have great influences at the affordability measurements and possible incentives to increase leverage and risk.

Together the factors mentioned above are related to the borrower's risk of defaulting on his mortgage loan. In this aspect two theories of default, the equity theory of default and the ability to pay theory of default will be considered and used as a guide in an attempt to understand whether borrowers react to purchase affordability or repayment affordability when considering their loan structure and leverage, and as a result whether their base default decisions is on equity or repayments. The relevance of consumption, savings and house price fluctuations is present when considering the borrower's risk of defaulting as the housing wealth is the largest single component of his total wealth. Through loosened credit constraints and changed legal framework making equity withdrawal easier for homeowners, the initiatives to increase consumption by higher leverage must be examined not least in Denmark where Danish households are the most indebted households in the world. Consequently, it becomes relevant to take a look at which loans the Danish homeowners prefer, to analyze the cost of mortgage loans at the market today and the risk involved. Furthermore it will be shown that for the owner-occupiers who do not borrow to finance their homeownership the risk is relevant, not at least when taking into concern their temptation to withdraw equity and join the group of homeowners who are exposed to the risk of defaulting on their loans.

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1. Introduction - Housing Affordability and its Problem Area

When studying Housing Affordability, many things become unclear regarding the definition and coverage of the topic. According to Gan & Hill (2009, p. 16) the problem of declining affordability in the recent years has been a popular subject in the media. Even though, the theoretical base of the concept has not been as popular among academics. Czischke (2009, p. 1) looks at housing affordability before and after the economic crisis and states the following:

“There is no single definition or measure of affordability”

In “Rethinking Federal Housing Policy” by Glaeser’s & Gyourko (2008, p. 1) the federal policy in housing issues is criticized and the authors point out two troubling affordability problems. The first problem pointed out is the fact that “the truly disadvantaged are too poor to afford housing even if it is inexpensively provided” and the second one is “that in a small but growing number of metropolitan areas, housing prices have soared, making housing unaffordable even for middle-income Americans”. The criticism is from a standard measure of housing affordability where it is considered “unaffordable” when housing costs are over 30% of the household’s income.

The concept “Housing Affordability” is related to, and dependent on, several factors. Wealth, equity, consumption, income, taxes, risk, leverage, house prices and debt are the ones most often mentioned and written about in literature. In addition, the borrowers mind and behavior has a critical role in the process of homeownership and affordability, not least when estimating the risk of default. The change in one’s affordability is a function of the factors mentioned above and the relationship is complicated.

Bramley (2012, p. 133) states that in the past 25 years affordability has become a more important issue in housing policy even though there still is a lack of agreed standards, mostly because of different views in how to calculate it and which measurements to use. In addition, Bramley points out the affordability problem first time buyers were confronted with in the years up to the crisis when house prices escalated faster than the income making it hard for new buyers entering the market without high risk related to high leverage.

The International Monetary Fund states that subsequent to the financial crisis in 2008 there has been an increased interest in macro prudential policy as a framework to address the stability of the financial system as a whole. In a working paper, several instruments are defined important in that purpose. Among those instruments two affordability ratios are mentioned, the loan-to-value ratio and the debt-to-income ratio (Lim et al., 2011, p. 4). Furthermore, the use of “Loan to value policy” in Hong Kong has played a main role

in holding the banking factor stable making it an important macro prudential tool (Hong Kong Monetary Authority, 2011, p. 164 and p. 168).

A very well-known affordability ratio, the price to income ratio, is mentioned in the OECD's working paper dedicated to investigate the housing market conditions. In the paper, the ratio is stated as one of two widely used indicators of the housing market conditions (André, 2010, p. 11). Those indicators are discussed in chapter 3.4.

The use of housing affordability as a poverty measurement and as another word for social housing has become more visible in the recent year (Heywood, 2013), see also (Glaeser & Gyourko, 2008 - chapter 1). Another aspect of the poverty housing affordability is introduced when Lerman & Reeder (1987) study the affordability of adequate housing where the quality based study of the housing affordability is made by distinguish those who can afford a minimum adequate housing and those who cannot.

It is necessary to distinguish between the many concepts of affordability and the endless definition of the subject as the concept has not yet been clarified and defined. The field is large and it is easy to get confused when writing on the subject. The three main categories when discussing and analyzing affordability are the problems of access into the homeowner market, in this thesis defined as *Purchase Affordability*, the problem of the burden of housing payments, in this thesis defined as the "Repayment Affordability", and the problems of "housing induced poverty" or social housing (Bramley, 2011, p. 2-3). In this thesis the first two concepts will be analyzed and explained. The last one is a large area of another source and concerns.

It is clear that there is no leading strategy or a guide which states how to measure housing affordability and different measurements are in use. In addition, different data are often used when calculating same ratios, depending on the analyst's definition of what is relevant and the data available. Available data differs between countries worldwide and in some countries the lack of data makes the work impossible.

Consequently, it is necessary to screen the literature and find out which ones are the most common and used in practice, as well as to look at criticisms and the misleads they might result in.

1.1 Problem Statement

“The ability of individual families to service their loans is a function of two factors: the level of their loan payments and the income and assets they have available to meet those payments. In planning their borrowings, families make assumptions about their future ability to repay their loans”

(Bucks, Kennickell, & Moore, 2006, p. A32).

This thesis is based on two simple and fundamental assumptions regarding the affordability dilemma the borrower faces when entering the housing market:

1. Can I raise enough funds for the down payment?

2. Can I service the mortgage debt and other consumption cost?

Those questions can be rephrased as the *Purchase Affordability* and the *Repayment Affordability*, respectively.

The affordability problem can be looked at from two perspectives, the lender's and the borrower's. Together, these two perspectives affect the whole economy as seen in the recent crisis. In this study, the concept *“Housing Affordability”* will be viewed from the borrowers perspective aiming at the impact and meaning it has for the borrower. The risk of default, as well as leverage, has in this context great impact and will be considered as well. Therefore, in order to diagnose the concept and its meaning for the borrower, the objective is to analyze it from the literatures perspective, to look at criticism and different views on the subject and to define the major ratios relevant for the borrower. The main problem to be solved in this area is:

What is Housing Affordability?

In order to answer the main problem the following questions will be answered:

- ***What does the literature say and how do they define it?***
- ***Why is leverage and risk so relevant?***
- ***How do different factors affect purchase and repayment?***
- ***What influences one's affordability?***
- ***Do buyers react to purchase affordability or repayment affordability?***
- ***How is housing affordability used in practice?***

To illustrate the importance and the effects for the borrower, the affordability ratios defined and chosen will be used in a sensitivity analysis for different mortgage loan types available at the market. The calculation illustrates the influences of changing financial and economic factors for the borrower. Those calculations will deepen the analysis and make it more realistic.

1.2 Theory

In this thesis, two different defined theories will be combined and used in order to explain and analyze the concept "Housing Affordability". The first theory defines the affordability concept and the other defines the borrower's risk of default. Together they reflect the ratios used in the sensitivity analysis and the two basic assumptions about the borrowers dilemma described in the problem statement.

1.2.1 Affordability Ratios

According to Gan & Hill (2009, p. 2) affordability can be defined in at least three ways. The *Purchase Affordability* which determines whether the household is able to borrow enough funds to buy an asset, the *Repayment Affordability* which determines the pay back burden on the household when paying off the mortgage and the *Income Affordability* which measures the house price to income ratio.

The two first affordability ratios, the purchase affordability ratio and the repayment affordability ratio reflect the buyer's two main decisions when deciding to enter the owner-occupier's market. The questions are whether he can raise enough funds for the equity share of the funding followed whether he is able to pay off the mortgage. In this context two theories of default are relevant, aiming at the risk and the willingness of the borrower not to default on the loan.

In the purchase affordability context, the loan-to-value ratio will be considered as this ratio describes the total leverage of the household as a fraction of the market value of the asset at the time given. When looking at the repayment affordability, four ratios will be discussed and explained. The debt service to income ratio (repayments) considers the household's monthly mortgage burden as a percentage of the household's income. The installments account for the amount of the total payment which goes directly to the principal of the mortgage often referred to as the Repayment service to income ratio. The interest service to income ratio accounts for the interest part of the whole amount used to pay off the mortgage. Finally the debt service to income ratio refers to the total mortgage debt as a percentage of the household's income. This ratio will be explained but not used in the sensitivity analysis in chapter seven. The income affordability is calculated by the market price of the house at the time given as a fraction of the household's income, as mentioned before. This is often referred to as the price to income ratio. The price

to income ratio is, as said before, one measurement of the affordability of housing, and is often used in affordability indexes as well as to describe the conditions of the market (André, 2010, p. 11).

1.2.2 Risk of default

Having decided to look at the affordability problem from the borrower's point of view making the assumptions that the borrower is confronted with the two ultimate affordability question introduced in the problem statement the risk of default must be taken into a consideration.

When evaluating risk between lenders and borrowers in financial agreements, the assumption of risk neutrality for both parties is often used to avoid making the analysis to become too difficult to work with. Some findings have even pointed out that whether the parties are risk averse or risk neutral does not affect the results of the analysis except for the fact that when assuming risk aversion with the lender, the results are more expensive payments for the borrower. Even though, the assumption of risk neutrality for both parties is considered to be restrictive so the assumption of risk aversion is preferred and considered the right way. See among others (Gale & Hellwig, 1985, p. 660) and (Pausch, 2005, p. 1-2). Kimball (1993, p. 589) takes the step further when he examines the standard risk aversion and states that in taking a single risk, one should be less willing to take another risk even though the two risks are independent and correlation between the two is weak. This leads to the conclusion that the borrower is risk averse in general and therefore he must consider the possibility of default when deciding to take a loan.

According to Jackson & Kaserman (1980, p. 678-679) two major competing views of the causal process involved in the default decisions of the mortgagor are relevant.

Those views are *the Equity theory of default* and *the Ability to pay theory of default*.

1. The Equity theory of default:

This theory holds that borrowers base their default decisions on a rational comparison of the financial costs and returns in continuing (or discontinuing) their periodic payments on the mortgage loan obligation. That is, they maximize their financial gains or minimize their financial loss that results from this decision. This view implies a strict optimizing behavior of mortgage borrowers.

The borrower's equity in the mortgaged property at time t is:

$$Q(t) = \begin{cases} V(t) - M(t) & \text{without default} \\ 0 & \text{with default}^1 \end{cases}$$

where $Q(t)$ is the equity, $V(t)$ is the market value of the property at time t and $M(t)$ is the outstanding mortgage debt in the property at time t .

2. The Ability to pay theory of default:

The second theory maintains that mortgagors, in general, will refrain from defaulting on the loan as long as their income flow remains sufficient to meet the periodic payment without undue financial burden. This view implies a satisfying mode of behavior of mortgagors.

The borrower's probability of default on the loan at time t is given by the probability that the income will fall to the payment, or below:

$$\Pr [D(t)] = \Pr [I(t) \leq P]$$

Where $I(t)$ is the mortgagors current income net of expenditures that, from the borrowers point of view, take precedent over the mortgage loan payment, and is assumed to be a random variable with density functions $g_t[I(t)]$ defined at each time; and P is the constant periodic payment to principal and interest on the mortgage loan, determined by the original property value and the financing terms applied to the loan.

These two theories of default, where the borrower is on the one hand concerned about his equity share in the property and on the other hand concerned about his ability to pay off the mortgage, refer to the purchase affordability and the repayment affordability, respectively. Having pointed the relationship between the affordability ratios and the risk of default it is interesting to see how leverage affects one's affordability and risk.

1.3 Motivation and object of the thesis

The motivation for the writing on the subject is the newest collapse of real estate prices after a historical price peak in the years before the financial crisis which started in late 2007. The consequences of the crisis where many families are technically insolvent; being unable to sell their apartments because of high leverage, makes the term "Housing Affordability" interesting to look at. The barrier for the first time buyer

¹ In Denmark the equity can be negative. In the case of insolvency in Denmark borrowers still owe the debt taken. The zero value in the case of default is therefore a minus value if adjusted to Danish circumstances.

to enter the market is also relevant and interesting to analyze in order to acknowledge the risk involved as well as how changes in the economy can affect the borrower's financial position. Having pointed out that many families are stuck in their dwellings unable to sell because of high leverage and the barrier for the first time buyer to enter the market it becomes clear that the affordability problem studied in this thesis does not only concern first time buyers as often discussed in the media, but also current homeowners. This thesis is written in order to understand what affordability is determined by and to analyze the determinative factors. Last but not least, it is important to see how changes in the economy affect one's affordability.

1.4 Methodology

The methodology used in this thesis is partly explanatory research and partly descriptive research. The additional use of a sensitivity analysis in the case study part of the thesis divides it into two main categories where theoretical findings are knitted together with mathematical calculations to describe the concept as well as the changes that occur with different economic circumstances. The basic assumption of the buyers dilemma when raising funds for the equity share of the investment and when paying off the mortgage is the main core and controls the different theories chosen. For the current homeowners the equity share and the leverage percentage of their homes becomes relevant, affecting their repayments and risk each time they refinance and/or take an additional loan in the investment. The basic assumptions lead to the usage of several different ratios chosen after the definition of housing affordability and risk where leverage plays an important role. In the explanatory part of the analysis, the affordability concept is studied from a literature overview in order to explain the many fields of the topic. In the descriptive part of the analysis the aim is to use the findings to describe the topic and explain the different aspects it is affected by. The sensitivity analysis is made to use the measurements defined and by calculations show how they are influenced by those aspects.

1.5 Structure

The thesis is structured as follows. Chapter two is dedicated to the three housing affordability measurements introduced in the problem statement. In that chapter different measurements will be introduced along with different house price indexes used by banks and other financial institutions. In chapter three, the term "Housing Affordability" is analyzed based on literature overview and the usage of the concept in practice where different definitions and methods are found on the subject. Chapter four focuses on leverage and risk. The user cost and taxes are the main topics of chapter five, followed by the relevance of behavioral economics introduced in chapter six. Chapter seven is dedicated to the sensitivity analysis on the purchase affordability and the repayment affordability. Interpretations on the findings from

the analysis are found in the same chapter. Chapter eight summarizes the conclusion on the housing affordability concept. References to literature used in the thesis are found in chapter nine and appendixes are found in chapter ten.

1.6 Limitation

When writing on such a broad subject as the housing market and its affordability problem is, it becomes difficult to do research on many housing markets given the coverage of the project and its size. Therefore, a limitation has to be set. In this thesis the Danish housing market has been chosen as a focus point and all assumptions used in this project are taken from the Danish mortgage market. Furthermore another limit must be set on the coverage of the project, taking into consideration the scope of the concept "Housing Affordability". Working through endless sources on the subject one realizes that there are many interesting aspects to look at, not least in the present crisis where the concept has located itself in the social housing area and poverty. Even though this side of the housing affordability is interesting, it will not be a main topic in this project and therefore not included. The housing affordability is not less relevant for current owner-occupiers as buyers entering the market for the first time. Even though the problem statement is partly based on the assumption regarding the purchase affordability and the problems the potential borrower faces when entering the housing market for the first time, the leverage is not less important for current homeowners who have indebted their homes close to or even above current market value. Or for those who have bought at high prices followed by a fall in house prices. For this group, the purchase affordability is just as relevant as for the new homeowners especially if the owner wants to sell. This group is in the same situation as the first time buyers regarding the main topic of purchase affordability, the loan-to-value ratio. For that reason it is relevant to point out that even though purchase affordability refers to the purchase of a home it can easily cover the current homeowners as well.

2. Housing Affordability Measurements

In this chapter the three affordability measurements chosen will be described and explained. In general, there are many ways to interpret the affordability concepts and when using them as a measurement it is necessary to decide which ones to use, how they are used and what they are supposed to show. Consequently, this chapter is dedicated to explain the purpose of the ratios in the sensitivity analysis in chapter seven.

2.1 Purchase Affordability

The purchase affordability describes, as the term refers to, the affordability at the time of buying. The definition is not simple because the ratio is not fixed and changes as the market conditions change. The

rate at time 0 is very unlikely to reflect the rate at any other time in the future. There are several ways to interpret the concept and the meaning of the concept is different, depending on the timing and the comparison of the measurement.

In most cases, the purchase of a real estate is a function of debt and equity², and together those factors reflect the buying price, or the market value, of the investment. The loan-to-value ratio considers the debt fraction of the total value of the investment and thereby also reflects the equity fraction of the investment as the two determine the price.

This leads to the following equations:

$$\text{Debt} + \text{Equity} = \text{Price}^3$$

$$\text{LTV} = \text{Debt}/\text{Price}$$

$$\text{ETV} = \text{Equity}/\text{Price}$$

Having defined the equations above two questions become relevant and interesting to evaluate:

1. How do the loan to value and the equity to value ratios look like at the time of purchase?
2. What happens when current homeowners want to sell⁴ and house prices have fallen?

2.1.1 The loan-to-value ratio

The loan-to-value ratio (LTV ratio) is probably the ratio most often seen and used when evaluating household leverage and as a result, the affordability and risk. The ratio describes how indebted the household is and expresses the ratio of a loan underwritten to a value of an asset at the time the ratio is calculated. As a result, the ratio is constantly changing depending on the market value of the asset and the remaining debt. The relationship between those two factors makes the ratio extremely volatile against price changes at the real estate market and changes in interest rates. As seen in the latest financial crisis where people, up to the crisis, could borrow up to 100% of the market value of the asset and subsequently where market prices fell nearly 30%, see figure 1.

² For the buyer who finances his purchase only with equity, no lending is needed.

³ Assuming the investment is financed by a mortgage loan.

⁴ People can choose to sell for several reasons such as in the case of divorce, death, lower expected income, retirement etc. The choice to sell is not in all cases a preferable choice but a choice of need.

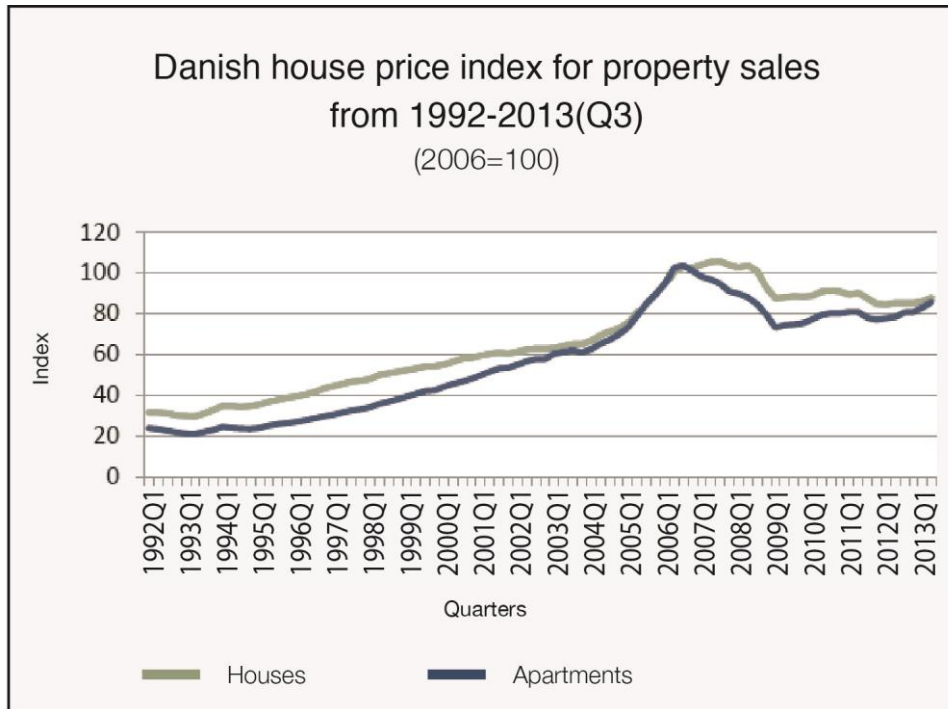


Figure 1. Danish house price index 1992-2013(Q3). Source: Statistics Denmark.

The graph shows the Danish house prices index from 1992-2013. House prices in Denmark have been falling since the peak in July 2006 where the house price index for apartments was 102.7 points. The house prices hit the bottom in February 2009 where the value was down to 73.1 points. This gives the result of 28.82 % price fall in 2½ years. The price fall in the last crisis has led to extremely indebted households where many homeowners have no possibility to sell the investment because the asset has become over indebted.

2.2 Repayment Affordability

The repayment affordability measurement can be calculated in various ways, depending on what is to be shown in the outcome. Basically, the ratio measures the financial burden to repay in a period when borrowing money. When considering a mortgage loan, several factors are included when repaying the mortgage and together those factors determine the repayment each time. The repayment consists of the installment, interest, the lenders fee⁵ and costs claimed by the authorities when obtaining a mortgage loan. Fees are usually added on the principal of the loan raising the principal of the mortgage debt. The installment varies after the outstanding debt of the loan, terms and interests set by the capital market. The lenders fee can be difficult to calculate and in some cases additional costs are hidden. This fee depends on the lender's tariff and regulation by the authorities.

⁵ Administration cost, risk premium and borrowing cost can be included in this amount.

2.2.1 Debt service to income - Repayments

The debt-service-to-income ratio measures the payments paid each month if the term on the loan is accounted for twelve payments in one year. This factor is the total payment per month including, interests and other fees and terms on the loan. When the loan is accounted for four times a year payments are adjusted to that.

2.2.2 Installments

The repayment-service-to-income ratio shows the installments, the part of the repayment which goes directly to paying down the principal of the loan.

2.2.3 Interest service to income

Interest-service-to-income ratio accounts for the amount paid in interest each month or four times a year in the case of quarterly payments. Other fees are also included in this ratio.

2.3 Income Affordability

According to Gan & Hill (2009, p. 2) *"income affordability simply measures the ratio of house prices to income"*. When reading through literature on the matter one finds out that this ratio can be used in various purposes depending on what to analyze and which results the researcher is aiming for. In addition, different indexes are needed to be calculated in order to construct the income affordability ratio. Those who calculate the indexes needed use different methods and data in their calculations. Gan & Hill (2009, p. 1) state that affordability is usually defined in the terms of house price to income ratio or the household's income to repayments or rent, the price to rent ratio. They refer to those measurements as the income affordability and the repayment affordability respectively.

2.3.1 Affordability indexes

In the US, the main providers of affordability indexes are the real estate institutes and government agencies. The three main indexes are calculated by the National Association of Realtors (NAR), US Department of Housing and Urban Development (HUD) and the National Association of Home Builders (NAHB). In Australia two of the three main providers of affordability indexes are made by banks in collaboration with real estate institutes while the third one is made by a consulting firm. In all cases, in the USA and in Australia, the indexes are based on the repayment affordability and the median or low income families taking into a concern median or low average income, median value house, fixed or variable mortgage rates and median loan repayments. In addition Demographia International considers the income affordability calculating the median price to income ratio in six different countries. None of these institutions mentioned consider or calculate the purchase affordability ratio (Gan & Hill, 2009, p. 3-4).

Country	Provider of Index	Income calculation	Based on
USA	NAR	Median monthly household income	Loan repayments on median house
	HUD	Median household income	Income to qualify for a mortgage on a median valued house
	NAHB	28 percent of a median household income	Fraction of dwellings sold that could be bought for the income
Australia	The Real Estate Institute of Australia	Median household income	Median loan repayments
	AMP (REIA/AMP)	Median household income	Median loan repayments
	BIS Shrapnel index	Average full time male earnings	Mortgage payments on a typical housing loan
	CBA/HIA	Median household disposable income	Income required for a typical first home loan

Figure 2. Affordability indexes in USA and Australia (Gan & Hill, 2009, p. 117).

Green (1996, p. 341) points out a number of limitations using these most common affordability indexes. In his critique on the National Association of Realtors (NAR) housing affordability index he points out that by focusing on a median family of four, those who already have a home are included. Green adds that those who already have a home have overcome the affordability barrier for the first time buyer and therefore they should not be included in the index. Furthermore, he states that not all families are made up of families of four and thereby the conditions made in the calculations do not apply to those households not including four members. The fourth thing criticized is that the first time buyer is not likely to buy a median priced house. Like Gan & Hill, Green also points out that the barrier to raise funds for the down payment, the purchase affordability concept, is totally neglected in the indexes.

2.3.2 House Price Indexes

House price indexes are an important factor in calculating affordability. In the US, there are various publishers of house price indexes and methods used to create them are different (for example FHFA/OFHEO, S&P/Case Shiller Index, CoreLogic HPI and IAS 360). House price indexes for durables such as residential housing are difficult to create (Englund, Quigley, & Redfearn, 1998, p. 172) and the main reason for that is the great variation on the quality of properties as stated in the original work on the topic introduced in 1963 by Bailey, Muth and Nourse (1963, p. 933). The price index created in 1963 was an index created by eliminating quality differences using regression analysis on repeated sales prices.

Englund, Quigley & Redfern (1998, p. 172, 173,195) discuss the importance of accurate house price indexes and the importance of understanding market behavior, its efficiency and housing bubbles. A new construction of house price index was made in 1996-97 where quality of the dwelling was taken into a concern by combining hedonic and repeat sales methods as well as cross sectional data and panel data from the Central Bureau of Statistics (SCB). The new method showed improved correlation between areas investigated suggesting that the housing market is less efficient than revealed in statistics shown before. The importance of accurate measurements is not least important for the return on assets and thereby the

risk involved as stated by Englund, Quickley and Redfearn (Englund et al., 1998, p. 194). For affordability ratios calculated from house price indexes, this difference between which measurements are used as a foundation for the calculations involved can be critical for the outcome.

2.4 Debt to income

There are two common ways to calculate the debt-to-income ratio. The first is to measure the total debt of the household as a fraction of the household's income. The second is to measure the debt obtained by borrowing for the purchase of a real estate as a fraction of the household's income. As the subject of this thesis is to analyze and look at the leverage and payment burden on different mortgage and not to make a personalized calculation, the debt to income is not used in the sensitivity analysis made in this thesis. For the population as a whole it is possible to show the evolution of the total debt or the mortgage debt. In the same way, the evolution of income can be shown.

3. Housing Affordability – the academic literature and use of housing affordability in practice

The *Housing Affordability* concept is widely used in many fields. The term is seen and analyzed in academic fields worldwide and used in practice by governments, financial institutions, mortgage lenders and different bank institutions. The aim is simple: to understand, analyze and define current and potential borrowers. The concept is used to understand and reduce risk, not only the borrowers risk and the lenders risk, but the risk of the entire economy and the possible financial fragility among banks and other financial institutions. It is not only used for mortgage borrowers. The concept is commonly used when measuring housing affordability among tenants housing consumption. Screening the literature on housing affordability highlights the many aspects and meanings on the subject as well as different criticism and views by the many scholars who have written on the subject.

3.1 When is housing affordable?

There are many views about when housing is affordable and how to measure the affordability, as mentioned before. With all the affordability ratios and data available and the many heterogeneous financial markets all over the globe the subject becomes difficult to analyze. There are not only meanings regarding which affordability ratios to use when calculating the ratios, in some cases there are different meanings about the priority of the measurements chosen. In some cases the ratios have different names over the same expression.

3.1.1 The expenditure to income measurement of affordability

Haffner & Boumeester (2013, p.1) make the tenant's affordability concept as a focus point at the ENHR 2013 conference and state the following:

"The usual way to represent affordability in the Netherlands is with the expenditure-to-income ratio⁶. It is shown that with this ratio one cannot say whether housing consumption is affordable for households or not".

The paper reveals that in the Netherlands the expenditure to income ratio (the net rent ratio measurement) is the oldest and most frequently method to measure the housing consumption expenditure (Haffner & Boumeester, 2013, p.6). According to Hulchanski (1995, p. 472) two rules of thumb are frequently used in the literature. The rules argue that rent ratios between 20% - 30% of the household's income are acceptable to declare the house affordable. If the households rent ratio exceeds the 30% limit, the house becomes unaffordable. The U.S. Department of Housing and Urban Development (HUD) defines the household "affordable" when expenditure on housing does not exceed 30% of the household's annual income. Spending more than 30% of the annual income on housing makes the household considered cost burdened and having difficulties in paying for necessities⁷. In other words, the housing becomes "unaffordable".

According to a statement on HUD's homepage the need for affordable housing has been rising since the economic expansion in the 1990s and the lack of affordable housing is worst among the population with the lowest income (U.S. Department of Housing and Urban Development, 2013).

3.1.2 The residual income measurement of affordability

Residual income is the net income left after subtracting the rent or the mortgage payment. Rent should be separated from other household expenses because this part of expenses is in most cases the largest one and not the one who is reduced in the short term (Haffner & Boumeester, 2013, p. 6). By using the residual income as a measurement when calculating the affordability, all other expenses and the households consumption is subtracted before the affordability ratio is measured. The main advantage for using the residual income instead of using the rent ratio (or the mortgage rent ratio) is that it expresses the possible consumption of the household (Haffner & Boumeester, 2013, p. 6).

The main differences between the net rent ratio measurement and the residual income measurement are showed in figure 3.

⁶ According to an email (received 3.9.2013) from Marietta Haffner, the method also refers to owner-occupiers.

⁷ Necessities would be defined as other consumption the household confronts.

Net rent ratio measurement	Residual income measurement
Household's net income	Household's net income
- Rent payments/payments of a mortgage loan	- Consumption
= Amount for other expenditures/consumption	= Affordability ratio

Figure 3. Net rent ratio measurement and residual income measurement.

In the net ratio measurement method the affordability ratio is calculated after the rent payments have been subtracted from the net income. There are many possibilities to calculate the rent payment and therefore, when using this method, the affordability ratio calculated can be very different depending on which size is used. Some calculations account for a predetermined mortgage loan where payment calculations are obtained from the mortgage payment from that product. Other calculations define a certain family size and a proper size of a dwelling that would fit the defined family size. The payment burden of a mortgage loan is then calculated as criteria. In the residual income measurement method the affordability ratio is calculated by the residual income left when the household has paid for other expenses and consumption. Several institutes calculate an average consumption for different household sizes and others calculate the poverty limit, the lowest possible income a household can be driven on. Again, the result depends on definition and selection of data. The behavioral part of household becomes relevant here as the household can choose which category to save money on and which one to spend money on. This can be critical for the generalization and the interpretation of the results.

The expenditure-to-income ratio is the traditional approach when analyzing housing affordability. This affordability method has been used due to the lack of suitable alternatives even though it has been subjected to continuous criticism due to its methodological weaknesses (Heylen & Haffner, 2013, p. 547). The residual income measurement has not been used in the same degree as the expenditure to income measurement. According to Heylen & Haffner the residual income is considered more precise and more useful when determining norms for housing allowances and mortgage loans. The residual approach is considered a better measurement than the expenditure to income measurement when measuring affordability where economic circumstances can be generalized for the sample chosen. When comparing across countries methodological advantages have not been found in the literature (Heylen & Haffner, 2013, p. 563).

3.1.3 The construction cost measurement of affordability

Glaeser and Gyourko discuss the use of generally accepted definition of affordability when the 30% limit is used in order to measure household affordability. The method confuses issues of income inequality with problems in the housing market. It is stated that in the USA the government react to the housing affordability problem by producing more houses. By producing more housing in order to solve the affordability problem the government will not be able to solve anything for the lowest income families as this group will not be able to afford a house even though more houses are produced. In that case, the affordability problem for this group is a poverty problem, not a housing problem (Glaeser & Gyourko, 2008, p. 16-17). For middle income families, the problem becomes larger as the minimum consumption measurements used in calculations does not apply to the middle class and as a result a better measurement is to calculate each outcome separately (Glaeser & Gyourko, 2008, p. 18). It is suggested to use another measurement to consider household affordability, to compare house prices to housing construction cost as this cost reflects the lowest possible way to deliver a house.

3.2 Affordability measurements used by the mortgage lenders

Danish mortgage lenders are credit analyzed before mortgage loans are granted. This credit analyze is done by the borrower's bank institution or by the financial institution that provides the mortgage⁸ and a proof of credit is made. The borrower has to provide documents about his private finance so the lender can calculate his affordability. These documents are information about income, copy of the latest tax report and overview over other expenses (Realkredit Danmark, 2013). When the total amount of the mortgage loan is calculated the monthly payments are usually never more than one third of the household's income⁹ (Danske Bank, 2013). The Danish law allows for up to 80% hypothecation of the buying price ('Finanstilsynet, 2010). This indicates that at the Danish market is using the purchase affordability ratio and the repayment affordability ratio to evaluating possible homebuyers. Which issues the potential borrower has to consider through the process of the loan appliance are introduced in chapter 6.6, along with the borrower's possible views to default on the loan.

3.3 Inconsistency between methods of affordability measurements

In Gan and Hill's three affordability measurements the purchase affordability, the repayment affordability and the income affordability inconsistency are observed. When discussing and distinguishing between the

⁸ The Danish mortgage borrower can apply for a loan at his private banking institution or at a special mortgage lending institutions who do not serve personal banking services.

⁹ When calculating maximum mortgage loan at the banks website a small box appears where it says that that the bank do not recommend higher expenses than 1/3 of the household's income. Information regarding maximum amount used to pay off the mortgage each month is not available for other Danish bank institutions.

three ratios, the purchase affordability ratio is unique compared to the other two ratios as it adjust to changes in the mortgage market and is thereby influenced by changes in credit restrictions while the other two ratios are immune to such changes. It was concluded that when measuring the different ratios in Sydney, Australia, over the period 1996 - 2006, the purchase affordability was unchanged while the repayment affordability worsened. The gap between the outcomes of the ratios is considered to exist because of the deregulation of the mortgage market at the time. Those deregulations led to higher house prices and easier funding resulting in higher leverage while the repayment affordability was stable (Gan & Hill, 2009, p. 116). The role of regulation and the access to funding is discussed in chapter 6.4.

3.4 House price used as indicator of the housing market conditions

The house price-to-income ratio is a widely used measurement of housing affordability taking the house price relative to disposable income into concern. When house prices rise relative to income, it becomes more difficult to buy and correspondingly, when house prices fall relative to income it becomes easier to buy (André, 2010, p. 11). This relationship between house prices and income influences demand at the market driving prices either up or down. Another ratio, the price-to-rent ratio, is used to measure the price of renting and thereby indicating whether owning a house is a good option comparing the cost of owning it relative to that of renting it. Again house prices are determinative, if house prices increase relative to rent more people choose to rent rather than to buy driving rents up and prices down. The relationship between the two measurements, the price-to-income ratio and the price-to-rent ratio, is again an important factor in determine the demand and equilibrium of the market. Within the two ratios, market prices are the main driver in determining the actions of the market, affecting the demand and whether people rent or buy. For that reason the two ratios have been used as indicators of the conditions of the market, determining if house prices are high or low. The price-to-rent ratio is described in the asset price model by Poterba (1984). In equilibrium, the user cost of owning a house is equal to the cost of renting it (André, 2010, p. 14).

According to the model, in equilibrium, rents are equal to the user cost¹⁰ of owning a house:

$$\mathbf{R = P (i + \tau + f - \pi)}$$

where R = rents; P = nominal house prices; i= after tax nominal interest rate; τ = property tax on owner occupied house; f = recurring holding costs consisting of depreciation, maintenance, and the risk premium on residential property; and π = expected capital gain on the house.

¹⁰ The user cost will be discussed in chapter 5.

The model accounts for a number of factors interesting to take a look at when considering affordability in general. Those factors are house prices, interest rate, taxes and the risk involved in the owner occupying situation and the possible gain (and loss) of owning a property.

There are number of limitations when using the price-to-income ratio and the price-to-rent ratio when using them to evaluate the market. When calculating the price-to-income ratio the average income of the whole population is taken as a denominator. The average income does not necessarily reflect the income of the potential buyers and the age group they belong to. In addition, affordability is affected by the changes in the household. Those changes are not taken into consideration in the calculations. Because most people finance their purchasing by borrowing, which incur additional cost for the buyer, financing cost should be taken into a concern. This financial cost is also relevant for the price-to-rent ratio as it appears in the interest rate considered in the model by Poterba. The characteristics and locations of rented apartments can differ and in many countries rent is tightly regulated and in many cases subsidized (André, 2010, p. 11).

3.5 Affordability, Unaffordable Housing and Poverty

In the USA a consensus has emerged that states that when housing costs rise over 30% of the households income the house becomes unaffordable¹¹. In this consensus the housing affordability is measured by comparing housing cost with income. According to Glaeser and Gyourko, this measurement of housing affordability is not realistic as it confuses income distribution with problems at the housing market. Outcomes generated by using this measurement cannot be defined as a housing problem, but a poverty problem as wages can in many cases be too low to overcome the limit of 30%. As a result, the authors come to the conclusion that a better affordability measure would be to compare house prices to construction cost as they consider the construction cost the lowest price to deliver a house in a given market. More evidence is shown that support the criticism on this use of affordability measurement where poverty and social housing problems faced by the government are linked to the calculation of the ratio (Glaeser & Gyourko, 2008, p. 16-23). Kutty makes the housing induced poverty as a main topic when introducing a new measure of housing affordability. The article considers the households standard of living and the fact when low income households cannot afford to pay for the poverty basket of non-housing goods after servicing the housing costs (Kutty, 2005). Quigley and Raphael (2004, p. 192-193) point out that the income factor can be a misleading when considering affordability, and in some cases poverty and affordability. The reasons for this mislead is because the statistic taken into concern when calculating income among a certain distribution includes those who have retired. This group of owner-occupiers is

¹¹ This measurement is, according to Glaeser and Gyourko, used by the Millennial Housing Commission, a number of U.S. Department of Housing and Urban Development (HUD) policies.

classified among the low income households because of the low retirement income this group normally receives, but that does not necessarily mean that this group is suffering poverty. As a result, people with low income but not necessarily low wealth are classified among younger households who have lower income and no wealth.

3.6 Affordability across housing markets

Housing costs vary between areas and the user cost of owner occupying house is more expensive in urban areas than in metropolitan areas. Including rural areas, owning and buying a house can be significantly cheaper than in the urban area. House prices are much higher in urban areas than in rural areas. When measuring affordability ratios where house prices and income are used¹², the income level and the productivity level has to be accounted as well. In addition the household's consumption and the mobility between areas are relevant as well and can change the affordability conclusion considerably when calculating whether the housing is affordable or not. The 30% approach of affordability becomes spectacularly problematic when comparing across markets, especially when looking at the middle class affordability. For a highly mobile population this factor becomes particularly relevant. The economic approach to such mobility is that high housing prices are balanced with high income and a pleasant quality of life and therefore, people are not paying a fixed percent of their income on housing. Glaeser & Gyourko illustrate their point by making an example of two different households where one is paying 20% of income on housing and the other one is paying 47% of income on housing. If the household spending 47% on housing consumption is earning more than the household spending 20% on housing consumption and the extra earning results in the same after-housing income, the 30% unaffordability assumption becomes unreliable. In this case the 30% limit does not make the latter household unaffordable as the after-housing income is the same in both cases (Glaeser & Gyourko, 2008, p. 19-21).

3.7 Inflation and affordability

Inflation has a significant influence on the economy as a whole. When looking at housing affordability the inflation has influences on most of the factors related to and accounted for in affordability measurements. Quigley and Raphael come to the conclusion that inflation affects the housing affordability negatively. They consider the HUD affordability index introduced and explained in chapter 2.3.1 where income and house prices are used as affordability measurements. According to Quigley & Raphael (2004, p. 194) increased inflation increases both nominal interest rates and house prices and those increases counterbalance the increases in nominal wages. As a result the inflation makes housing less affordable. Inflation and the owner-occupiers user cost is discussed in chapter 5.1.3 where inflation participates in lowering the user

¹² The house price to income ratio, referred to as the income affordability according to Gan & Hill.

cost of owner-occupied housing in the case of appreciation of house prices, making housing more affordable.

4. Leverage and Risk

When writing on the subject “Housing Affordability” one must understand that even though there is a difference between the two main topics analyzed in this thesis, the purchase affordability and the repayment affordability, there is need to make a further distinction on the subject where risk and leverage have a great influence. When analyzing the first time buyer of housing where the buyer has to raise fund for the down payment, the loan-to-value ratio is an important tool to avoid over pledge on the property and thereby risk. At the time of buying, assumptions are made on the development of the equity and the repayments, assumptions that should avoid the borrower from liquidity problems. On the other hand, when analyzing those who already own housing and for some reasons want to sell their properties, one can easily be confronted with other circumstances than estimated at the time of purchase. If house prices have fallen drastically and/or the principal of the loan has increased, the leverage may have changed resulting in increasing risk for the borrower and the lender. In some cases, the borrower can be “stuck” with his apartment, unable to sell because of too high leverage. Leverage and risk are two different terms over influential elements in the housing affordability concept. It is, in the housing affordability concept, difficult not to mention one when considering the other as the leverage concept can easily convert into a great risk factor. The interaction of those two influential terms when considering housing affordability is close and they are depended on each other.

4.1 House price fluctuations and increased leverage

House price downturn has a great influence on the risk of owning. According to Lunde (2008, p. 2) owner-occupiers housing price risk is increased during house price downturn and a growing number of house owners have negative equity and payment problems. As a result, arrears and foreclosures become an increasing problem within the group of homeowners. In the same study, Lunde argues that when house prices start to fall, the probability of continuing fall in the next year is more than 50%. For the owner-occupier, the risk is reduced again when house prices increase and the cycle turns around again. The owner-occupier’s interest rate risk is not affected when house prices fall but his borrowing conditions might have worsened due to higher risk premiums and cost related to borrowing. In the same sense access to mortgage is less due to higher leverage and therefore lower equity (Lunde, 2008, p. 18). The borrowers who are buying their first home face a risk when house prices are rising. This group is, due to high market prices, able to obtain higher leverage in the investment as the maximum loan to value is determined by the

market prices and thereby the borrower is exposed to increased risk when prices fall. In Denmark this group of new homebuyers consists mostly of young families, as most people buy their first apartment before the age of 40 (Lunde, 2008, p. 21).

Leverage and risk are two different sides of the same coin. If one is able to obtain a higher loan the leverage is increased making the investment more risky. When the borrower is able to achieve a higher leverage on his mortgage investment his purchase affordability is improved, understood in the sense that he has easier access to enter the owner occupied housing market. At the same time his purchase affordability and his loan-to-value ratio is worsened, especially in the case of house price fall after the purchase where the leverage is further increased and at the same time the risk of default. The repayment affordability is affected in the same sense as the payment of mortgage debt at the time of high house prices is higher than in the case where the purchase is done when prices are lower.

The influences of leverage and equity position because of house price decreases are shown in figure 4.

	At the time of purchase	20% decrease of house prices	30% decrease of house prices
Value of the investment	4 million DKK	3.2 million DKK	2.8 million DKK
Mortgage loan 80%	3.2 million DKK	3.2 million DKK	3.2 million DKK
LTV - Loan to value	80%	100%	114%
Equity	20%	0%	-14%

Figure 4. House price decreases, loan to value and equity.

4.2 Payment burden, Liquidity and Solidity

The mortgage rate, which serves as a proxy for the payment burden, is positively correlated with mortgage default risk (Wong, Fung, Fong, & Sze, 2004, p. 39-41). In this aspect there are two critical risk factors, the borrower's liquidity and his solidity. According to Bergmann those two risk factors have a great importance when the borrower is choosing between different mortgages available at the market (Bergmann, 2007, p. 22)¹³.

4.2.1 Borrowers Liquidity

The borrower's liquidity is highly dependent on the development of the repayments in the following year after the mortgage is obtained. Here it is critical whether the borrower is able to fulfill the first year's

¹³ Information about Danish mortgage loans can be found on the following web site: <http://www.rd.dk/da-dk/privat/koeb-bolig/Laantyper/Pages/laantyper.aspx>

repayment. The liquidity is also dependent on interest fluctuations and the development of the interest rate in the coming future. If the borrower chooses a mortgage with variable interest rate he must be able to meet changes in the repayment of the loan, at least when the interest rate rises (Bergmann, 2007, p. 22). When the borrower chooses a mortgage loan with fixed interest rates he has steady payments but the interest rate is set higher in the beginning making the total repayment of the loan higher¹⁴.

4.2.2 Borrowers Solidity

The borrower's solidity is dependent on the borrower having the financial strength to repay the loan without exactly knowing future economic changes and fluctuations. The borrower might be forced to mortgage redemption due to changes in the economy. These changes can be in the household's income, a divorce, unemployment, moving, etc. If the redemption amount does not cover the total cost of selling the house, the borrower becomes insolvent (Bergmann, 2007, p. 22). Here, the house prices at the market are critical and in the case of a house price downturn the consequences can lead to insolvency, especially if the house was bought at the time of house price upturn.

4.2.3 The Owner-Occupier's Liquidity and Solvency

The owner-occupier's risk position in housing debt is determined by his equity and liquidity. The legal consequences of negative equity if the owner-occupier is unable to serve his debt are the same whether the owner-occupier's debt consist of mortgage secured by house collateral or a personal bank loan (Lunde, 2008, p. 18-19). Figure 5 shows the possible situations the household can be in aiming at liquidity and solvency.

	Positive Equity / Solvent	Negative Equity / Technically Insolvent
Liquid	No problems	No payment problems, capital payments ensure future improvement of solvency
Illiquid	Raise a loan	Financial reconstruction (where lenders reduce the debt size), otherwise foreclosure

Figure 5. Owner-occupiers liquidity and solvency (Lunde, 2008, p. 19).

¹⁴ Not necessarily over the whole period. But the first year payments are probably higher. If the inflation in the future becomes higher than expected when the loan was given the fixed rate loan can end up with lower payment burden than the variable interest rate loan.

With liquidity and positive equity owner-occupiers are mostly unaffected when house prices fall as they can choose to stay in their houses or to sell it. The capital loss is equal to the net present value of the future costs of holding the home¹⁵. In the case of selling the price downturn at the market influences the purchase of a new dwelling in the same way as it already has done with the previous one so arbitrage is not possible.

With liquidity and negative equity owner-occupiers can stay in their dwellings without any problems unless they for some reason become illiquid and unable to meet their financial obligations. The risk in this situation is based on the lenders risk aversion and the leverage ratio of the real estate involved. In Denmark, the maximum loan-to-value ratio is 80% of the market value of a real estate and in some cases buyers take bank loans to even further pledge. The investment is in most cases taken as collateral. When house prices fall, the household can easily end up with negative equity.

Owner-occupiers with illiquidity and positive equity have the possibility to refinance their loans and thereby can negotiate for softer payment profiles or longer terms on the loans in order to adjust to worsened repayment affordability. Alternatively they can confront the problem by taking another or additional loan. Those who take the latter possibility can end up with negative equity if house prices fall even further.

The owner-occupiers who are illiquid and at the same time have negative equity are in a poor situation to negotiate. The possible solutions in this scenario are foreclosure, involuntary sale, restructuring of the debt or reduction of the debt (by the lender). In the two former cases the family moves out of the house but in the two latter ones the family stays in their home (Lunde, 2008, p. 19).

4.2.4 Those who don't borrow

Not all homebuyers borrow when they purchase a home. The homebuyers who have the equity to buy their houses without borrowing do not commit themselves financially in the same way as the ones who borrow. They are therefore free for many of the risk factors the borrower assigns to and the purchase is without leverage in the start. Even though, the investment is not risk free for this group of homebuyers. The investment can incur a loss, for example if house prices fall. This leads to the conclusion that the decision to purchase a house will never be risk free neither for the ones who borrow nor for the ones who own the equity to finance the purchase. This project is dedicated to the ones who borrow. Even though calculations are made for those who do not borrow at the time of purchasing. The reason is to point out the scope of the risk even when leverage is not relevant.

¹⁵ Here the transaction costs of buying and selling are not included.

4.3 Interest rates

When applying for a mortgage loan the borrower faces many options regarding which loan to choose and on which terms¹⁶. One of the many decisions he has to take is whether the loan is to be set by fixed rates or variable rates. Those who choose fixed rates have the same interest rates throughout the repayment of the loan and the risk they take is the one related to fall in the interest rate where they could have paid less interest if they had not been set as fixed. Normally, interest rates on fixed interest rate mortgage loans are higher than those on variable interest rate mortgage loans. The borrowers who choose variable interest rates on their loans settle for the uncertainty and fluctuation of the interest rate in the future. This group can expect changing repayments throughout the period and has to be able to confront higher repayments when the interest rate rises. If interest rates rise significantly, the owner-occupiers risk is increased as well.

4.4 Systematic and unsystematic risk

At the financial market and in economics two types of risk can be identified for investments. The systematic risk, sometimes referred to as the market risk, is the risk of the entire market and cannot be avoided through diversification. This risk is dependent on both macroeconomic and microeconomic variables. The risk the borrower is exposed to is the risk related to the housing market and factors that influences the market as a whole. Factors relevant here are the price fluctuations at the market, changes in interest rates and regulation and changes at the mortgage market. The unsystematic risk is the risk inherent in each investment and this risk can be reduced through diversification. Homeowners are exposed to both systematic risk and the unsystematic risk. At the mortgage market, when people obtain a mortgage loan in order to finance the housing investment, the diversification of the investment is not possible for the borrower and he takes the risk for "selecting" only one investment is his portfolio. This makes the investment highly risky for the borrower and as a result he is highly exposed to the unsystematic risk.

4.4.1 Systemic risk

The systemic risk is the risk of a collapse of the financial market or a certain market as a whole. This risk is measured for the whole economy where many different risk factors threatening the system are evaluated together to predict the risk of a collapse. The housing market is a large size in this matter and a great influential part when evaluating systemic risk as the housing market is a large size in the whole economy. Even though the housing sector has a great role when estimating systemic risk, an increased systemic risk can trigger the risk factor of the housing sector. The relationship between the two is cyclical. The loan-to-value ratio has been used as an instrument to reduce systemic risk. In Denmark and many other countries

¹⁶ More information about mortgage loans at the Danish mortgage market can be found on the following website: <http://www.rd.dk/da-dk/privat/koeb-bolig/Laantyper/Pages/laantyper.aspx>

there are limit on the maximum loan-to-value ratio as stated before. In Denmark this maximum is 80% of the market value of the real estate at the time of obtaining the mortgage loan ('Finanstilsynet, 2010, Chapter 1. Paragraph 20). According to the International Monetary Fund caps on the loan-to-value ratio has, among other instruments, been used in several countries in order to address systemic risk in the financial sector. Ten instruments are identified to be used to achieve macro prudential objectives and caps on the loan-to-value ratio is among them (Lim et al., 2011, p. 8). This ratio has been increasingly used to try to reduce systemic risk that often rises from real estate pricing booms where people have been able to borrow more because of high market value of the asset because of the price boom effect. When using the loan-to-value ratio to reduce the systemic risk of the entire financial market, a limit on the mortgage loan is set well below the market value of the asset (Lim et al., 2011 , p. 64).

4.5 Reducing the borrowers risk

The reduction of a risk, when financing and repaying a real estate mortgage, is always an advantage regardless of considering the risk from the lender's or the borrower's perspective. Even though the following points are thought in favor for the borrower the influences will always be in the favor of the lender.

4.5.1 Diversification of the mortgage loan portfolio

According to Rasmussen, Madsen & Poulsen (2011, p. 190); a decent loan counseling should take into a concern loan conversion, loan portfolios, the borrower's horizon and his risk aversion. The paper introduces a mathematical optimizing model whose aim is to improve mortgage lending counseling as well as to adjust it to the borrower's circumstances and risk aversion. When calculating the repayment affordability a focus must be set on and the borrower's best interest, the length of the loan customized to the borrowers need and his risk aversion. This will lead to a more personalized counseling than served today. By customizing counseling in this way it is possible to increase the borrower's gain without increasing his risk (Rasmussen et al., 2011, p. II-III). In the paper it is concluded that if the borrower follows a few principles the model accounts for, a gain would be observed in most of the period analyzed, see figure 6.

The risk factor has to be quantified	The borrower should choose loan portfolios instead of a single mortgage loan	The uncertainty regarding the loan horizon has to be taken into account	The importance of repayments affordability should be taking into a concern rather than aiming at loan products available at the market	All mortgage loan counseling should be adapted to new circumstances and changes in the economic environment
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Figure 6. Principals for the borrower to follow in order to maximize gain without increasing risk.

Even though the report focuses on the conversion of a mortgage loans when they are due and to optimize the gain from that conversion as well as to reduce the borrowers risk and save transaction cost, the report gives more evidence. It introduces new parameters and methods, not used in today's handling at the mortgage market when borrowing for the purchase of a home, and how those parameters can optimize the borrowers gain. Today, the option to choose a loan portfolio instead of a single mortgage loan is not available and todays counseling is rather to introduce the products available rather than calculating the borrower's preferences and needs. The borrower's risk aversion is neither taken into a concern nor to a consideration. By inducing those new methods, the borrower's risk could be reduced significantly.

4.5.2 Hedging House Risk

"Choosing to own a home is not only a consumption decision. It also entails a portfolio choice"

(Englund, Hwang, & Quigley, 2002, p. 168)

Markowitz's modern portfolio theory (Markowitz, 1952; 1991) attempts to maximize the portfolio's expected return for the total risk of the portfolio. The maximization is reached through a diversification of the portfolio. The model calculates the expected return from a proportion of the weight from each asset in the portfolio. For a portfolio that consists of two assets; A and B the expected return is:

$$E(R) = \omega_A E(R_A) + \omega_B E(R_B) = \omega_A E(R_A) + (1 - \omega_A) E(R_B),$$

where w is the weight of each investment in the portfolio and $E(R)$ is the expected return of each investment, A and B.

For a portfolio that consists of individual securities r_1, r_2, \dots, r_n that are jointly distributed random variables, the return on the portfolio is:

$$R = \sum_{i=1}^n X_i r_i$$

The expected mean return on the portfolio is:

$$E = \sum_{i=1}^n X_i \mu_i$$

where $\mu_i = E(r_i)$

In the making of the model, Markowitz (1987, p. 4) assumes that investors are risk averse and that they prefer to increase their consumption.

Even though Markowitz's model has been used with success in many years as a calculator for portfolio return and the risk involved, it has not yet been implemented into the field of home ownership and the great unsystematic risk an owner-occupier engages when he makes the financial obligation of buying a home. The optimal selection of investments in a portfolio in order to decrease risk is to choose investments with low correlation. By choosing assets with low correlation the risk is diversified. The low correlation between housing and other assets supports the notion that the house would be a good contribution to diversify a portfolio and reduce the risk. According to Englund (2002, p. 168-169), different proposals have been made in the attempt to improve the possibilities to hedge the risk and share it. See among others Case, Shiller & Weiss (1995) and Caplin, Chan, Freeman & Tracy (1997). So far, the attempts have not been successful in practice. Englund concludes that this lack of success is due to legal and practical problems. Englund continues by stating that younger and poorer households hold a large fraction of their portfolios in their homes and as a result, these groups pay a high cost measured in increased risk. Taking into a concern the housing affordability concept and the poverty aspect of the subject, often referred to as a social housing, the results in the study are interesting for the poorer homeowner. The results indicate that the value of hedges to reduce risk is for this group surprisingly large (Englund et al., 2002, p. 187). For the lending institutions, this part of the analysis could be worth investigating further.

5. User cost and taxes in owner-occupied housing economies

The user cost of owner-occupancy is often referred to as the real cost of owning as it takes into a concern all aspects of home ownership. The user cost is also used to measure the cost of owning compared to the cost of renting.

5.1 User cost and owner-occupied housing

The user cost of owner-occupied housing is the cost of services provided by an owner-occupied housing unit incurred by the household consuming those services (Díaz & Luengo-Prado, 2012, p. 1). André (2010) defines the user cost of owner-occupied housing in his study on the OECD's housing markets¹⁷.

André uses Poterba's housing valuation model of user cost (Poterba, 1984) and introduces the owner-occupiers user cost:

$$R = P (i^a + \tau + f - \pi)$$

where R represents rents, P nominal house prices, i^a the after tax nominal mortgage interest rate, τ the property tax rate on owner-occupied houses, f the recurring holding costs consisting of depreciation, maintenance and the risk premium on residential property and π the expected capital gains on the house (André, 2010, p. 14).

The user cost is an important tool when studying housing consumption, not least when considering housing affordability. According to Miles (1994) the user cost is the best analytical method to evaluate how the tax system, financial markets and the housing market works. In addition it is extremely important when studying the incentives of home purchasing. The user cost formula is found and introduced in several versions depending on whether the subject is owner-occupying housing, financed by mortgage lending or by equity, or rental housing. The user cost takes into account relevant costs and benefits, interest rates, economical depreciation (or appreciation), tax rates, expected inflation, subsidies, tax credits and tax depreciation (Bourassa & Hendershott, 1994, p. 75). The user cost and its infrastructure does not only depend on house prices but also available credit at the market, insurance role against rental price risk as well as current and expected transaction costs (Díaz & Luengo-Prado, 2012, p. 228). According to Bourassa & Hendershott (1994, p. 78) the user cost implies substantial inequities. Households with low income and less wealth pay higher after-tax cost for each unit of owner-occupying housing than those who have higher income and more wealth. Renters also pay a higher price for housing and have far lower income than owner-occupiers when looking at the life cycle average of these groups.

5.1.1 The shadow price for owner-occupied housing

Households who decide to become owner-occupiers instead of being rent paying tenants equate the marginal rate of substitution of housing services for nondurable consumption to the price of renting. This

¹⁷ In the paper André studies the housing valuation model by Poterba are used to examine the influences of the user cost of housing on the price to rent ratio. According to the model equilibrium state occurs when rent equal the user cost of owner-occupied housing and the fundamental price to rent ratio is achieved.

comparison, the shadow price, is what households base their decisions on when deciding on homeownership or tenancy. The shadow price of housing services is in that sense equal to the rental price of housing. The owner-occupiers who have wealth and do not finance their housing by mortgage loans have a lower shadow price of housing service as the mortgage payment is not included in the size. Taking the owner-occupiers user cost into a consideration the defined shadow price respects current and future expected transaction costs, past return on equity holding in the investment, cost of mortgage payment (if not fully financed by equity), maintenance and property taxes minus expected capital gains. Again, the user cost and subsequently the shadow price is depending on the wealth of the household. The shadow price of owner-occupied housing is not equal to the rental price of housing when taxes are included¹⁸. The individual income is taxed, no matter whether the income is provided by labor or by rent. At the same time the individual is allowed to deduct local taxes from his taxable income, but not from his rental income. In addition, owner-occupied housing services are not taxed, no matter whether the owner-occupier has a mortgage to pay or not making the difference between the rental price and shadow price even more intense (Díaz & Luengo-Prado, 2012, p. 230-231).

5.1.2 Expected user cost and effective (ex post) user cost of owner-occupied housing

The owner-occupier's user cost can be explained in the terms of expected user cost and the effective (ex post) user cost of housing. Having defined the expected user cost as the same as shadow price for owner-occupied housing it becomes interesting to look at the actual cost of owning taken into concern the non-convex adjustment costs and the uncertainty in house prices. When accounting for those factors the relationship between the shadow price of housing ownership and the real cost of homeownership leads to the existence of the expected user cost and the effective (ex post) user cost (Díaz & Luengo-Prado, 2012, 231). The factors considered when estimating the effective user cost are the buying cost of the purchase of the house, the loan-to-value ratio that represents the return on equity, the cost of mortgage, possible capital gains, the maintenance costs, selling costs and taxes¹⁹. This method of calculating the user cost is different from the method used by Poterba & André discussed earlier. In this method, transaction costs are included and a distinction is made whether there is a cost of borrowed unit when financed by a mortgage loan or whether the funding is generated from own wealth ²⁰(Díaz & Luengo-Prado, 2012, p. 231). According to Díaz & Luengo-Prado different loan-to-value ratios as well as different time of house purchasing makes user cost varies across households, even though located close to each other. Furthermore, the difference between the expected user cost and the effective user cost depends on the

¹⁸ It is lower when taxes are included.

¹⁹ All terms are discounted by the after tax interest rate except the buying costs.

²⁰ Here referring to the taxes on the return on the asset and the mortgage interest deduction, respectively. In Denmark tax deduction from mortgage lending is approximately 30% of interest expenses (skat.dk).

interest rate spread, the bias that occurs because the owner-occupier's housing services are not taxable, the adjustment costs and the difference between actual capital gains and losses.

5.1.3 Inflation and owner-occupier's user cost

Quigley and Raphael (2004, p. 195) show the importance of the inflation when calculating the user costs. They start with the simple equation of the user cost:

$$R = (i + t + d - g)V \quad (1)$$

where R is the housing rent or the opportunity cost of housing, i is the interest rate, t are the taxes, d is the depreciation and maintenance and g are the capital gains at real rate. V is the value of the property. This equation is the same as the one introduced by Poterba and André earlier, not taking into a concern the ex post user cost discussed in chapter 5.1.2.

The inflation influences nominal interest rates and nominal house price appreciation. When taking into a consideration the nominal interest deduction (further discussed in chapter 5.2.1) as well it is clear that the inflation reduces the after tax user cost of capital. The following equation shows the user cost of owner-occupied housing when the inflation has been taken into a concern, incorporating the nominal interest rate deductibility and property taxes deduction:

$$R = ([i + a][1 - T] + t[1 - T] + d - [g + a]) V \quad (2)$$

where inflation, a, has been added to equation 1 in order to show the effects on interests, taxes and the cost of capital. T is the marginal tax rate²¹. In the case of appreciation of house prices the user cost for owner-occupiers is lowered but in the same time the appreciation has great effects on the affordability for those who are entering the market for the first time and do not own a property as the purchasing price is now higher. This appreciation consequently leads to higher loan-to-value ratio and increased risk²² (Quigley, John M, Raphael, Steven, 2004, p. 195-196). The influences of inflation are relevant when calculating the owner-occupier's user cost of home ownership and the importance can be tremendous in economies who are struggling with high inflation. This part of the user cost should therefore not be ignored, especially not within countries facing high inflation²³.

²¹ The marginal tax rate is the amount of tax paid on additional unit of income. As income increases the amount of taxes paid increases.

²² For those who finance their purchase by mortgage lending.

²³ Iceland is an economy who has been struggling with hyperinflation ever since the financial crisis in 2008. Before that the inflation was above the average comparing to advanced economies. In addition the majority of Icelandic mortgage loan are index loans so the inflation is also affecting the mortgage cost factor of the user cost as well as the equity.

5.1.4 House prices and the owner-occupier's user cost

When considering the yet unmentioned factor in the user cost equation, the house prices, the academic literature become of limited use because of the extreme house price changes that have occurred in the past 20 years. Many attempts have been made to explain the evolution of house prices in order to set things into a perspective but explanations are different and the concrete explanation is still undetected. The extraordinary house price changes in the past years seem to be a mix of several factors such as more open markets worldwide with free movement of capital, changed regulation regarding financial movements and investments as well as changed credit restrictions, lower interest rates up to the financial crisis in 2008, increased risk position among mortgage lenders and financial investments and thereby easier access to money²⁴ and last but not least, the behavioral part of the human being.

5.1.5 The implementation of BASEL III

By the introduction and implementation of the BASEL III financial institutions who serve the market as lenders are, in the next seven years, required to increase their liquidity coverage ratio (LCR ratio) up to 100%, starting in 2015 with 60% minimum LCR ratio and by 2019 with 100% minimum LCR ratio (Bank for International Settlements, 2013, p. 2). In addition banks will be required to guarantee adequate stock of unencumbered high quality liquid assets that consist of cash or other assets easily convertible into cash (Bank for International Settlements, 2013, p. 4). This action will influence homebuyers as well as other borrowers in the coming future as the banks will have to raise funds in order to fulfill this new regulation. It is very likely that those funds will be raised by further and increased fees when borrowing²⁵.

5.2 Taxes and owner-occupied housing

“All policy changes create winners and losers, and economists have enough difficulty inducing politicians to adopt efficiency - improving policies without overstating the losers' losses.”

(Bourassa & Hendershott, 1994, p. 90)

Among owner-occupiers, taxes are of great influences no matter whether the house is financed with own equity or a mortgage loan. In most countries, homeownership has tax advantages because the return from the asset is largely not taxed. Furthermore, most countries do not tax capital gains on houses and the imputed cash flow/rent owners pays to themselves is taxed lightly and in some countries not at all. In

²⁴ After the crisis mortgage lenders have tighten their restrictions when considering peoples affordability.

²⁵ An example of higher fees can be seen in appendix 2. A calculation on the administration cost valid from 2014 compared to the administration cost for 2013.

addition the mortgage interest deduction from the taxable income is allowed in some countries²⁶ (White & Hendershott, 2000, p.3.). Same issues are discussed elsewhere by Capozza, Green & Hendershott (1996, p. 172.) and Se (2013, p. 4).

5.2.1 Mortgage interest deduction

The mortgage interest deduction gives the mortgage borrower allowance to reduce the taxable income by the amount of interest paid on their mortgage loan²⁷. The use of the interest deduction is possible no matter whether the housing, in the beginning, is financed with own equity or with a mortgage loan. A homeowner who finances his home purchase with own equity can thereby use advantages of the tax reduction by later obtaining a mortgage loan on his property. Subsequently he can use the money lent to invest in a fully or partly taxed asset. Therefore, the investors who finance their housing with equity benefit the same tax advantages as the ones who borrow. By changing this equal treatment of equity and debt financing by policy and legislation changes, financial behavior used by the ones who own equity for the purchase, and therefore are not depended on borrowing, could be modified. Homeowners would not be able to withdraw capital from their houses in order to invest in tax sheltered assets (or other investments) and at the same time enjoy the mortgage interest deduction (Capozza et al., 1996, 172-173.). Se states (2013, p. 4) that the mortgage interest deduction encourages leveraged financing of housing and the ones who purchase a home with own equity and subsequently withdraw equity to invest in other assets might be encouraged to higher leverage because of the mortgage interest deduction.

5.2.1.1 Mortgage interest deduction when marketable wealth exceeds or equals the house value

For households where marketable wealth exceeds or equals the market value of the house, the possibility to borrow money in the form of mortgage loan where interests are deductible is not available and therefore the deduction is of no value (White & Hendershott, 2000, p. 11).

5.2.1.2 Mortgage interest reduction and the loan-to-value ratio (LTV)

The loan-to-value ratio is affected by the mortgage interest reduction. Capozza, Green & Hendershott (1996, p. 174-178) test the influences of the mortgage interest reduction on the loan-to-value ratio and find evidence on decline of the mortgage debt if the interest deduction would be removed in the USA. In the absence of mortgage reduction, the decline in the loan-to-value ratio is approximately 40%. Data from Australia, where the mortgage interest deduction is not allowed, is used to compare to data from the USA. The comparison between them shows similar results. In Australia the observed loan-to-value ratio is

²⁶ In Denmark, taxpayers are allowed to reduce their taxable income by the amount of interest paid on their mortgage loan.

²⁷ In Denmark the deductibility is approximately 1/3 of the interest paid.

approximately 40% lower than in the USA. Follain & Melamed (1998) get similar results when they investigate the removal of the mortgage interest deduction on debt and revenue. It is argued that the households hardest hit by the removal of the deduction are young upper-middle-income households, especially those under 35 years of age. The wealthier households are less likely to be affected by the removal as they have other assets to offset the loss.

5.2.2 Taxes on imputed rent

In Australia, neither taxes on imputed rents nor mortgage interest deduction have been used by the authorities in order to claim taxes on owner-occupied housing. The taxation has though been advocated on the ground of efficiency and equity reasons and most of the developed countries base their taxation on mortgage interest deduction. Within the group of owner-occupiers in Australia the tax system with no taxation or deductibility favors the households with high income and low debt (Bourassa & Hendershott, 1994, p. 73). The ones with lower income and higher debts (and higher loan-to-value ratio), often the younger category of homeowners are better served with taxation and deductibility. This group of young homeowners is, according to most literatures and analyses, the group that confronts the housing affordability problems though purchase affordability problems and/or repayment affordability problems. The affordability problems are mostly related to high debt ratio (household debts and other debts) and as a result, difficulties to meet financial obligations, or problems related to purchase affordability problems by not being able to enter the owner-occupier's market.

The influences of the taxation on imputed rents and mortgage interest deduction would, in the case of Australia, not influence young households in the same way as the elder ones. For married couples between the ages of 25 to 54 taxes of imputed rents would be a better option financially than a tax on other income of the household. For the elder households with less debt and even more funds these changes would have worsened effects²⁸ (Bourassa & Hendershott, 1994, p. 73, 90-91).

5.3. The undetectable advantage of owner-occupancy

Having explained the user cost of homeownership and pointed out that this cost is the additional cost of repaying the loan when being an owner-occupier as well as to address the taxable side of this cost, the advantages of homeownership must be mentioned as well. There are solid reasons for people choosing to enter the group of homeowners. Being a homeowner gives the opportunity and freedom to tailor ones house to own tastes and needs. Those who own their dwellings benefit from the sound consequences of

²⁸ In Australia the system of imputed rent taxation and mortgage interest deductibility has not been practiced before and this group of homeowners has therefore already missed their chances for maximum mortgage interest deduction in the past but would be taxed as everybody else.

decisions regarding maintenance and renovation. Those advantages of being an owner-occupiers has to be weighed against the transaction cost (and the user cost) of having homes (Englund et al., 2002, p. 167-168). The security of owning instead of renting becomes further relevant when looking at the tenant's risk of being resigned the renting contract and he therefore is forced to move. This security becomes more important when supply of rental properties are scares or/and when the tenant has children in his care. Speculations about the undetectable advantages of owner-occupancy must be taken into a concern when analyzing on the topic. Sometimes this advantage can be hard to capture and measure.

6. Behavioral economics and affordability

„Det ville være bedst, hvis folk selv tog ansvar“ – „It would be best if people took the responsibility“

(Due, H)²⁹

According to Quigley & Raphael (2004, p. 191-192) economist are "wary, even uncomfortable" with the housing affordability problem. The distribution of house prices and their quality, the distribution of income, the ability to borrow when purchasing a house and public policies affecting the housing market as well as the supply of new and renewed houses are mentioned in this context. The last thing mentioned is the factor probably most difficult to measure, the behavioral part of the housing affordability problem.

The choices that people make and how they decide to allocate their consumption and spending have a great influence on their affordability position. The interpretation of housing affordability, even the basic fact, is difficult because of how these different factors are connected together. This makes the term behavioral finance where consumption and other decisions the individual might take, a necessary part when discussing and writing about housing affordability. In this chapter different methods and theories from the literature are introduced. Those methods and theories do all have in common the attempt to predict and explain people's actions and preferences so that they can be used in the best way to serve the economic mystery of combining and synchronizing numerical data with the human mind and behavior.

6.1 Behavioral Economics

"Behavioral Economics" is the combination of psychology and economics that investigates what happens in markets in which some of agents display human limitations and complications"

(Mullainathan & Thaler, 2000, p. 1).

²⁹ Due, H. (2011). Det ville være bedst, hvis folk selv tog ansvar, interview with jens lunde,lektor cand.polit. Retrieved 14.8.2013, 2013, from <http://www.information.dk/271478>

In a standard economic framework the behavioral part, studied by cognitive and social psychologist, is normally ignored or ruled out (Mullainathan & Thaler, 2000). This fact confirms how difficult it is to include it in economic models and calculations and to consider it when applying those calculations in different analysis and observations. When studying and analyzing housing affordability the behavioral part of people's actions and preferences, and thereby their choices and decisions, has crucial effects on the outcome. The influences are not only relevant for the household involved but also the economy as a whole. The existence of the behavioral part of economics must be taken into a concern even though literature and existing theories on the topic are of limited use when trying to apply them directly into calculations. The current financial crisis and changes in the mortgage loan environment in the last two decades have made the behavioral part of the housing affordability much more relevant than before as it has had great significance on leverage and the risk part of the topic.

6.1.1 Savings and the standard economic model of human behavior

According to Mullainathan & Thaler (2000) the standard economic model of human behavior includes three unrealistic traits. These traits are *the unbounded rationality*, *the unbounded willpower* and *the unbounded selfishness*. In addition, the behavioral economic research programs consist of two components. The first one is to identify the ways in which behavior differs from the standard life-cycle model and the second one is to show how this behavior matters in economic context. The traits and programs mentioned can be applied to the field of private savings. The standard life-cycle model of savings is originated from bounded rationality and bounded willpower. Saving for a retirement is a blend of difficult cognitive problem and a difficult self-control problem. According to the life-cycle model, those who earn most of their income in the early stage of their life should save the income to be able to increase consumption in the future. In the same sense the theory states that those who earn most of their income later in life should borrow from future income to pay for increased consumption earlier in the life. The principles of this theory are inconsistent with data showing that consumption follows the income level of the individual through his life cycle. In addition consumption decreases significantly as individuals retire and their income is lowered because they have not saved enough for their retirement. Furthermore there are many households who do not have the capability to save money as their income is too low (Banks & Blundell, 1998, p. 772-773). The lack of self-control is mentioned as well as a reason for the lack of saving. The theory is supported by the fact that almost all saving in the USA is done through "forced savings". Forced savings are defined as savings through mortgage payments which accumulate the home equity position and pension funds.

6.1.2 The permanent income hypothesis

Friedman's permanent income hypothesis (1957, p 25-26) defines the ratio between permanent income and permanent consumption. According to the model the ratio depends on interest rates, the set of interest rates the consumer can borrow and lend, the importance of property and non-property income and a variable "u" determining the consumer's taste and preferences for consumption versus his addictions to wealth.

6.1.3 The behavioral public economic model and the neoclassical model of decision making

The behavioral public economic model of decision, the BPE model, is based on behavioral economics, psychology and neuroscience. The model is used to design public policies as an alternative to the common neoclassical model of consumer decision-making (Douglas Bernheim & Rangel, 2008). Both models are used in savings policies in order to find out how individuals make their decisions and preferences. The neoclassical model assumes that behavior can be affected if circumstances change the decision maker's information or budget constraint. The behavioral model assumes that individuals attempt to optimize their preferences and at the same time that they randomly meet conditions that trigger systematic mistakes. When applying the two methods on retirement savings different conclusions are observed using the same data in the analysis, depending on whether the behavioral economic model is applied or the neoclassical (Douglas Bernheim & Rangel, 2008, p. 6).

6.2 Private consumption and savings when house price fluctuate

"Affordability expresses the challenges each household faces in balancing the cost of its actual or potential housing, on the other hand, and its non-housing expenditure on the other, within the constraints of its income"

(Heylen & Haffner, 2013, p. 549)

The existence of the influences of the behavioral part on the housing economics is clear in the following example from the UK in the period between 1989 and 1992. House prices fell and at the same time, private savings rose. The view at the time was that while house prices still were falling, private consumption would be at low level and as a consequence, the economic recovery would not happen (Miles, 1994, p. 4). This is the same thing as has happened in the present crisis in Denmark where private consumption has been low while house prices have been falling and private saving rises at the same time. As shown in figure 7 the relationship between house prices, savings and household consumption has been as described by Miles above.

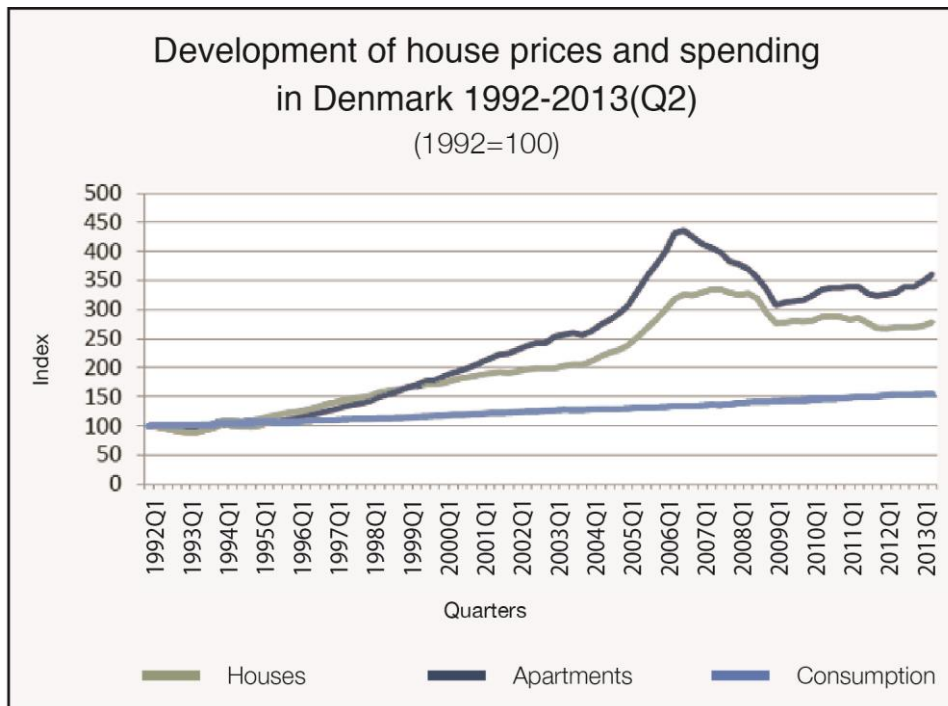


Figure 7. House price development and consumer price index. Source: Statistics Denmark

After a period of house price downturn, low consumption and increased savings house prices have in the last months been rising in Denmark³⁰. At the same time, people have spent more money and private savings are falling. According to Juul-Jensen, Danish consumers have become more optimistic in the recent months. Increased private consuming, increasing car sales and installments on mortgage loans are evidence thereabout (Juul-Jensen, 2013a; Juul-Jensen, 2013c). Danish people are getting more optimistic and believe that house prices are recovering and rising again (Juul-Jensen, 2013b) and (Kristensen, 2013). See also a study from the knowledge center for housing economy (Boligøkonomisk Videncenter, 2013) where an optimism regarding the future economic circumstances is observed. Beliefs observed in reports and studies, as mentioned above, are examples of expectations that control peoples actions and furthermore the economic circumstances at the market. Figure 8 and 9 show the evolution of household savings in Denmark. Figure 8 shows total household savings in 1992-2013. Figure 9 shows total savings by labor on payroll and retired labor in the period between 2000 and 2013. Both figures show an upward trend in household savings in August 2013. It is impossible to speculate whether this turnaround is permanent or not. The turnaround in the recent months and the uncertainty whether the turnaround is permanent or not is another example of how unstable the market still is.

³⁰ Especially in larger cities in Denmark influencing the average rate upwards. This can give misleading information regarding small cities where prices are not rising.

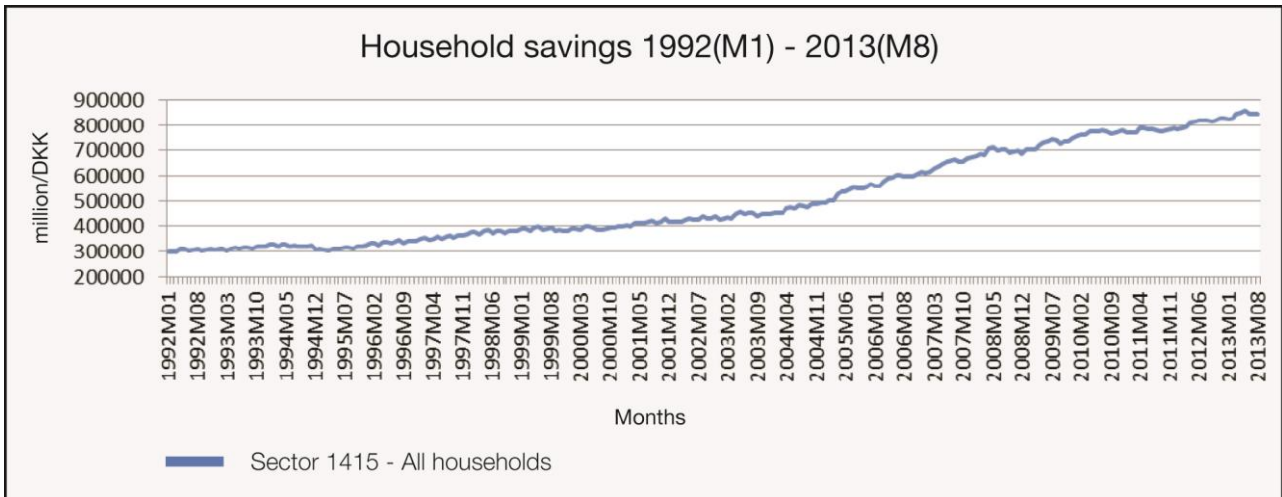


Figure 8. Household savings, all households. Source: Statistics Denmark.

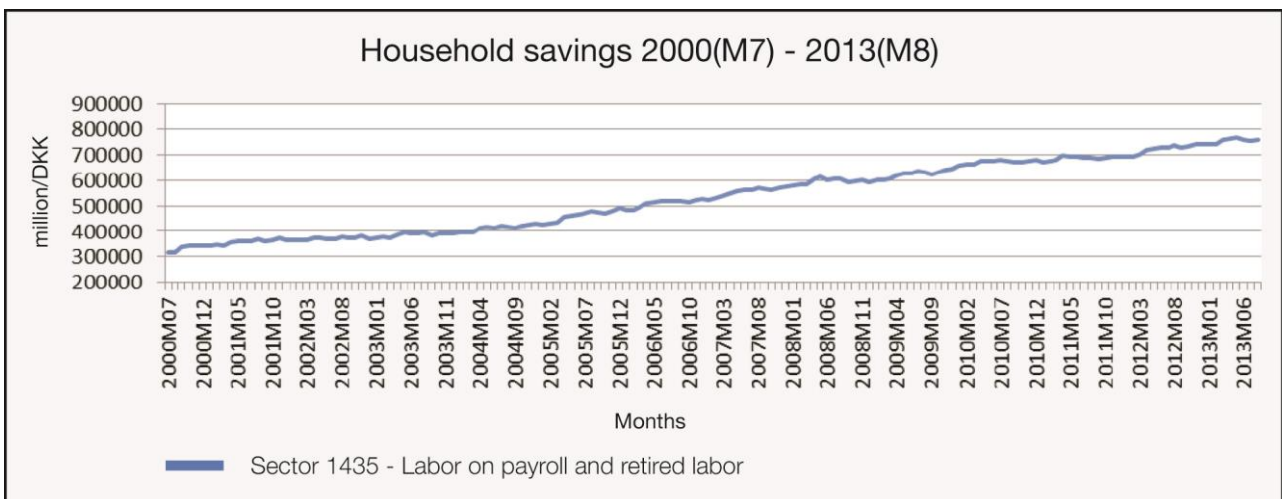


Figure 9. Household savings, labor on payroll and retired labor. Source: Statistics Denmark.

According to Miles (1994, p. 4-5) there are two explanations for the behavior described in the UK in 1989-1992 and observed in Denmark in the present crisis. The first one is that the housing wealth held by the personal sector (the value of the owner occupied housing stock net of the value of outstanding mortgage) is the largest single component of their total net worth. According to Deaton's life cycle theory of consumption (1988) consumer's expenditure depends on human capital and the value of tangible and financial assets. Unanticipated changes in wealth will thereby affect expenditure. Therefore, one can assume that increase in total net worth increases the private consumption. The second explanation is the boom in house prices that influenced the expenditure further. Miles concludes that house prices have

direct impact on consumption, both in theory and practice. The consumer expenditure in the UK rose dramatically in the late 1980's and the consumption was mainly financed with equity withdrawal leading to the conclusion that people withdrew equity because of rising house prices.

Andersen & Kennedy (1994, p. 38-39) state that the life cycle model of savings provides a useful framework about household saving and consumption as the current consumption is conditional on expectations on life time income and the stage of the life cycle the household has reached to. Some versions of the model state that if the household expects increase in wealth it can increase consumption. Expectations about increased interest rates can influence the household to save money. Clear evidence are found on the relationship between household savings and real house prices, and constraints like financial deregulation and liberalization are considered as a great influential factor when looking at the evolution of those sizes (Andersen & Kennedy, 1994, p. 31-36). Quigley & Raphael (2004, p. 194) state that housing choices are combined and reflected by consumption activities such as schools, neighborhood and other environmental circumstances. Furthermore it is stated that households are very unlikely to adjust their consumption on short run changes in the economy.

6.3 The withdrawal of equity

According to Lunde (2010, p. 66) the former view, that borrowers make a solid financial plan when taking a loan in order to pay the loan down in the next 30 years, does not exist anymore. By the refinancing and restructuring of the mortgage loan system in the period from 1970 until 1992-3, borrowers are now able to withdraw equity from their investments as house prices rise. Furthermore borrowers who choose to do so increase their risk when prices go down. The fact that today interest-only mortgage loans in Denmark³¹, first introduced in October 2003, account for 51%³² of the total volume of mortgage loans is an evidence of a withdrawal of equity as well. The private consumption is, in this case, increased by lower payment of the mortgage instead of direct withdrawal of equity. According to the International Monetary Fund (World Economic Forum, 2012, 104) same evidence are found in Iceland in the years up to the financial crisis in 2008 where equity withdrawals became possible through the refinancing of mortgage loans. The ability to withdraw equity from the housing asset was a result of privatization and liberalization of the banking system in 2003. The action made it easier for households to increase their consumption. The loan to value limit was raised to 90% by the state owned housing finance fund but the private owned banks provided loans up to 100% of the market value of the investment in their attempt to increase their market share³³.

³¹ With interest-only payment in the first ten years.

³² Data received from Egstrup, R; Danmark Statistics.

³³ The subject could easily lead to another interesting topic where moral hazard in the financial environment is taken into a concern and subsequently, its influences on housing affordability, leverage and risk.

As a consequence, many current homeowners refinanced their loans and withdrew extra equity to pay for debts such as bank account overdraft and other loans that had been obtained as well as to finance other consumption. New homeowners, entering the housing market for the first time, also obtained higher mortgage loans to pay debts and in many cases higher mortgaged loans were obtained to refurnish the new home or to finance other consumption³⁴. For the bank providing the loan, the underlying security for previous consumption loans and bank account withdrawals was now more stable and secure with a real estate as collateral for the total debt of the household.

The contraction of consumption among households in the latest crisis seems to be results from house price declines and increased leverage (World Economic Forum, 2012, p. 103).

The motives for the withdrawals of equity are further discussed by Lunde (2010, p. 70). Motives such as loss in income because of education, maternity leave and retirement are taken as an example. In addition the motivation to increase private consumption because of unexpected wealth is mentioned as well. Lunde is consistent with the view of Miles and Andersen & Kennedy introduced in chapter 6.2 when he states that increases in house prices reduce saving propensity and expands private consumption propensity (and the opposite in the case of decrease in house prices).

6.4 New evidence on the relationship between housing wealth and consumption

Browning, Gørtz & Leth-Petersen (2013) find a little support for the wealth explanation on consumption for Danish households. They reject the former empirical findings suggesting that house prices and consumption are synchronized and positively correlated. Four existing explanations on the correlation between house prices and consumption are considered in the paper. Those explanations are the following. The explanation based on the life-cycle hypothesis on the influences of house prices on wealth, the role of house capital as collateral available for homeowners making the withdrawal available in the case of house price upturn, the influences of the financial liberalizations in loan constraints leading to easier access of funding and the explanation that house prices and consumption are influenced by the expectations on productivity growth that affects both wages and expected income in the future. In this thesis, the first three explanations have already been discussed.

When examining the empirical data to support the importance of the wealth effects from house prices consumption among Danish households in the period 1987 to 1996 a little support for the wealth

³⁴ The author of this thesis was employed as a mortgage counselor during the period where the Icelandic banks in 2004 started to provide mortgage loans to the private sector.

explanation is found. The findings conclude that house prices are persistent but stationary³⁵ implying that that a price shock does not have permanent effects on wealth except for households about to exit the market. No relationship is found between housing consumption and house prices before 1993. After 1992 no evidence are found that support that older homeowners react to house prices, ruling the wealth factor out as an explanatory variable for the correlation between house price changes and the growth rate in expenditures. Positive and significant relationship is observed between unanticipated house price innovations and consumption among young households who are considered to be constrained. It is concluded that this correlation is due to the financial reform in 1992 loosening credit restrictions on mortgage loans (Browning et al., 2013, p. 422-423).

Aron & Muellbauer (2013) explain consumption behavior by credit liberalization and wealth in a research made on consumption behavior in South Africa between 1971 and 2005. The findings from the paper include a critic on the previous models of consumption behavior. It is stated that the existing empirical literatures could be strengthened with better controls for house prices and consumption. The importance of the direct effects of legislation and credit constraints is neglected leading to bias in results, especially in countries where credit constraints have been loosened. Results from the analysis in South Africa suggest that the major rise in consumption in the period analyzed is related to loosened credit constraints in the period leading to easier access to credit.

6.5 Homebuyers' expectations during the crisis

Case, Shiller & Thompson's questionnaire survey (2012) about homebuyers' expectations and their reasons for buying and selling was undertaken in 1988 and again annually during 2003-2012. The aim of the survey was to understand and observe peoples thoughts through and after the crisis as well to look at possible causes of the crisis. The main findings of the survey are that there is strong correlation between answers given by the participants of the survey and the actual outcome, indicating that home buyers are well informed of the trends in house prices at the time of buying. Participants in the survey were, in general, well informed according to the report. Short run expectations were rather underreacted than too optimistic compared to the actual outcome while long run expectations about prices were more optimistic among the group asked indicating it as a root for the bubble that later exploded.

6.6 The theories of default

When obtaining a mortgage loan the borrower is said to adopt either of the two theories of default, the equity theory of default or the ability to pay theory of default, introduced in the theory chapter within the

³⁵ Do not change when shifted in time or space.

problem statement. Which theory he adopts reveals whether he is concerned for his equity position in the investment or his ability to serve the debt. The loan guide from Nordea credit (Nordea bank, 2013b) is a guide for the possible mortgage lender regarding the mortgage product available³⁶. In Nordea's guidance, the borrower is asked questions regarding his personal holdings to the expected purchase and future expectations.

The following is an example of questions asked:

- 1. How do you expect your income to evolve in the next 3-5 years?*
- 2. How long to you plan to keep the home?*
- 3. Can you act to changing payments?*
- 4. Is it important for you to have a positive equity in the investment?*
- 5. How many years do you want to pay interest-only mortgage?*

The questions above are examples of how the mortgage lender tries to solve the challenging role of mortgage counseling and at the same time he tries to reduce his risk as much as possible³⁷. The questions include a concern on the equity position and the payments as well as the importance of the borrowers concerns and importance on these factors. There are many uncertainties for the borrower to speculate and consider. Some of them are unrealistic to expect him to comment on as they can guide him to the wrong selection of a product if he for example guesses or chooses randomly³⁸. The subject of how to achieve the optimal mortgage counseling is not a subject to discuss further here but rather whether borrowers act on the repayment factor or the equity factor of the loan they are about to obtain.

For current homeowners the consideration and concern can be whether they are concerned about the current equity possession or the payment burden, that is, in the case of refinancing whether they do it to withdraw equity from the investment or to achieve lower payment burden (for example in the case where interest rates are set to a lower level). For first time owner-occupiers the question is related to the amount

³⁶ The guide is submitted to Nordea's own loan products but similar guides can be found for the other mortgage lenders as well.

³⁷ Many have tried to solve the problem of personal mortgage and loan counseling. See for example (Rasmussen et al., 2011).

³⁸ The interest rate forecast is an example. The bank institutions and other speculators have difficulties when forecasting the forward interest rate so the borrower is in general not expected to be better informed on the matter. Another example is to ask how long he wants to pay "interest only interest-only but not if he is interested in that kind of payments at all.

borrowed and the incentives to obtain the maximum amount available³⁹ and the monthly payment of the amount borrowed. Today's evidence on high leverage when obtaining loans as well as high refinancing numbers and equity withdrawal indicate that today, homeowners are not as concerned about the equity factor on their investment but rather their ability to pay. The repayment affordability and the purchase affordability are calculated by the lender who subsequently sets the frame for the affordability limit for the borrower. It seems therefore that borrowers use the loan to value limit set by authorities and the mortgage lenders⁴⁰ as a benchmark for what is appropriate to borrow. Loosened credit restrictions in Denmark since 1993 and then again in 2003 have possibly moved people's limits in equity possessions and in the same way changed their views in the direction that as long as they can service the debt (and other consumption) the equity is not as relevant. Unfortunately many have forgotten to take into a consideration the risk that increased leverage brings⁴¹. The group of homeowners who chooses the refinancing of a loan, an action which incurs additional transaction costs and fees, is most likely to care less about the equity position and more about their ability to repay the remaining debt.

7. Sensitivity analysis

In this chapter the two affordability ratios, *Purchase Affordability and Repayment Affordability*, will be used in a sensitivity analysis on different loan types and leverage⁴². The assumptions used in the analysis are shown in figure 10:

Value of the investment in the purchase affordability	3 million DKK
Value of the investment in the repayment affordability	1 million DKK
Maturity	30 years
Repayments per year	4
Terms	120
Interest rates	Fixed and variable

Figure 10. Assumptions used in the sensitivity analysis.

Four types of mortgage loans will be considered. Fixed rate bonds, fixed rates bonds with ten years "interest only" payments, variable interest rate loans and variable interest rate loans with ten years "interest only" payments. For the mortgage loans with variable interest rate, review on interest rates is

³⁹ Set by the maximum loan to value of 80% or the maximum loan-to-value ratio plus the extra lending from the bank.

⁴⁰ When taking an additional bank loan to pay the remaining 20% of the purchasing value.

⁴¹ Here the risk of falling house prices and the risk of being able to service the debt in the case of lower income is most relevant.

⁴² Detailed calculations on all four types of loans calculated can be found in appendix 4.

done in every five years. In the sensitivity analysis on the purchase affordability a value of three million DKK investment will be used in order to show how equity and debt evolve after house price fluctuations. In the sensitivity analysis on the repayment affordability, payments are calculated per million DKK.

At the Danish mortgage market four loan types are the most popular among borrowers. As shown in figure 11 the Danish borrowers prefer mortgage loans with variable interest rate where installments are not made on the principal. This type of mortgage loans accounts for 36% of the total. The fixed interest rate bonds follow by 28%. Variable interest rate loans where installments are made on the principal are chosen by 21% of the borrowers. Least popular is the fixed interest bond where only interests are included in the monthly payment for the first ten years of the maturity. This type is chosen in 15% of the cases.

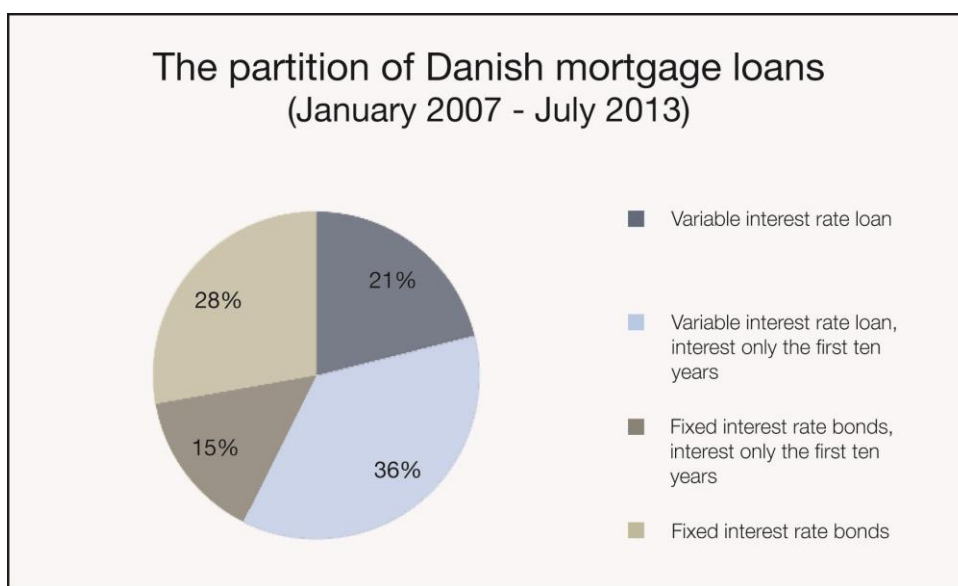


Figure 11. The Danish mortgage loan market (data received from Egstrup, R., Statistics Denmark).

The main providers of mortgage loans in Denmark are Real Kredit Danmark, Nykredit, Nordea Kredit and BRFKredit⁴³. The Danish mortgage lenders offer a broad range of products that, in general, are similar even though introduced differently. In addition some of these institutions offer bank loans, not only to those who exceed the 80% mortgage limit and need extra funding to their investment, but also as a competition to the mortgage loans available at the market. In the following analysis two mortgage loans are selected for the sensitivity analyses, mortgage loan with fixed interest rate and variable interest rate loan⁴⁴. Both loans are then considered as interest-only mortgages for the first ten years.

⁴³ For further information about these institutions see the agencies' web pages: <http://www.rd.dk>, <http://www.nykredit.dk/>, <http://www.nordeakredit.dk>, <http://www.brf.dk/>

⁴⁴ The loans considered here are available at Nordea bank Denmark. Obligationslån 30 år med afvikling, Obligationlån 30 år med afdragsfrihed i 10 år, Rentetilpasningslån 30 års løbetid F1 med afvikling og Rentetilpasningslån 30 års

7. 1 Sensitivity analysis on the Purchase Affordability

In this sensitivity analysis the leverage and evolution of equity is taken into a concern⁴⁵. In addition the capital gains and losses are addressed in each situation. The loan-to-value ratio is calculated from different aspects and premises and the equity possession at each time is considered as well. Four different leverage scenarios are set up in order to show how different equity position in the beginning can influence the evolution of the equity in the future. According to the evolution of house price index showed in figure 1 the volatile assumption of 30% house price changes are made in the following calculations. In the purchase affordability sensitivity analysis the assumption of a purchase value of three million DKK is set instead of estimating per million DKK. The amount chosen is not critical for the calculation when taking into a concern the mathematical aspect. The ratios are calculated on a percentage base and therefore they will adjust to any given size. Of course, as the purchase amount escalates the risk is increased at the aggregate level for the borrower as the mortgage loan increases with increased purchase price. The escalation affects the repayment affordability and the risk of default grows.

løbetid S1 med afdragsfrihed op til 30 år.

(<http://www.nordea.dk/Privat/L%C3%A5n/Bolig/Sammenlign+I%C3%A5n/1440432.html>).

⁴⁵ The principal is held fixed in this calculation. In the reality the principal is lowered by each installment so the time at the appreciation/depreciation is relevant regarding the remaining debt when the equity and the loan to value are calculated.

Purchase price 3.000.000 DKK	
The structure of funding	
0% EQUITY - 100% LEVERAGE	
Equity financing	0
Mortgage financing 80%	2.400.000 DKK
Bank loan financing 20%	600.000 DKK
20% EQUITY - 80% LEVERAGE	
Equity financing 20%	600.000 DKK
Mortgage financing 80%	2.400.000 DKK
50% EQUITY - 50% LEVERAGE	
Equity financing 50%	1.500.000 DKK
Mortgage financing 50%	1.500.000 DKK
100% EQUITY - 0% LEVERAGE	
Equity financing 100%	3.000.000 DKK
Mortgage financing 0%	0
The house price fluctuation - all types of funding	
Market value at time 0	3.000.000 DKK
Market value when prices appreciate by 30%	3.900.000 DKK
Market value when prices depreciate by 30%	2.100.000 DKK

Figure 12. Structure of funding and house price fluctuation.

In figure 12 four different options of funding possibilities are introduced for the potential buyer, depending on his own equity at the purchase time 0. The equity funding of 100% is the case where a mortgage loan is not needed for the investment and the purchase is financed by own capital. When the buyer finances his housing purchase with 100% equity he decreases his risk significantly. Even though the investment is not completely risk free and the risk of house price reduction exist. In the opposite case of 100% leverage the borrower does not have any equity at the time of purchase and he is, after the maximum 80% mortgage loan he is able to apply for, forced to finance the remaining 20% of the purchase value by obtaining a bank loan at higher interest rates than normally given when obtaining a mortgage loan. In the years up to the financial crisis in 2008 loans were frequently granted up to 90% to 100% of the value of the investment. In USA especially these loans were often granted in relation to the commonly known subprime mortgage loans where the credibility of the borrower was not evaluated before granting the loan. The funding when 100% of the purchase value is borrowed is most probably the case that comes closest to the reality today as many house purchases are now financed by little or no equity at all. The case where the purchase is financed with 80% mortgage loan and 20% bank loan is the one that reflects the government's legislation rule for a maximum loan of 80% mortgage lending mentioned before in the thesis. The 50% calculation of own equity and leverage is included as it illustrates that even with 50% own funding in the beginning

volatility of house prices can affect the equity possession and leverage considerably. Therefore, the risk is no less relevant when potential buyers have substantial equity at the time of purchase. Together the loan-to-value ratio and the equity position sum up to the market value of the property at the time of purchase. Those ratios are formed by the purchasing value at time 0 and the market value at other times in the future (and the debt at the given time). The equity possession and the buying value of the property therefore determine the loan-to-value ratio at time 0. At any other time in the future, the market value of the property sets the new loan-to-value ratio and the equity possession⁴⁶.

7.1.1 No equity – 100% leverage

As shown in figure 13 and 14 the effects on the loan-to-value ratio, the equity position and the capital gains and losses are apparent as prices go up and down. With no equity at the time of purchase the loan-to-value ratio is 100% of the purchasing value⁴⁷. When prices appreciate by 30% the owner-occupier has gained 900.000 DKK and his loan-to-value ratio is lowered by 23% which now is his equity possession in the investment. By the appreciation the loan-to-value ratio falls from 100% down to 77%. This borrower has now the possibility to refinance his current loan for the 3% he has to the limit of 80% leverage. If his application is granted he has the opportunity to increase his consumption by 120.000 DKK as the 3% are now calculated from the new market value – 3.9 million DKK - but not his buying price at time 0. If prices depreciate by 30% again after he has obtained the new loan the 100% loan-to-value ratio he had in the beginning is now raised up to 104% ($3.120.000/3.000.000 = 103.9\%$)⁴⁸.

Returning to the starting point of the borrower with no equity at the beginning it can also be assumed that after his purchase house prices depreciate by 30%. In this case the former 100% loan-to-value ratio is increased to 143% of the market value of the property and the borrower still faces the risk of further depreciation. An owner-occupier in this situation has no possibilities of selling, unless he can find capital to cover the hypothecation. For households in this situation possible changes of life circumstances, changes such as a divorce, wanting to buy smaller apartment or simply the desire to move to another neighborhood is impossible things being equal. For those households a focus must be set on the repayment affordability and not to default on the loan.

⁴⁶ Here including as well the remaining principal of the debt. Interest rates can increase the remaining debt and installments on the principal decrease the remaining debt.

⁴⁷ According to the rule a minimum down payment of 5% is needed so the additional bank loan accounts for 15%. The size is very small compared to the total value and in the year up to the crisis 100% lending was used f.x. in the USA and in Iceland. Therefore in this example, the “no equity” possession will be used.

⁴⁸ In this example, transactions costs and fees are not included. When those taken into a concern the loan-to-value ratio would be higher or the amount for increased consumption is decreased.

7.1.2 20% equity – 80% leverage

The risk of over leverage is still very relevant when the buyer has 20% own capital at the time of purchase. By a depreciation of 30%, the equity possession becomes negative placing the owner-occupier in the same situation as with no equity in the beginning where the loan-to-value ratio exceeds 100%. If he, for some reason, wants to sell the home he has to provide the 14% of over leverage he now faces after the depreciation. Own equity of 20%, from the time of purchase, is lost and his equity position is now negative by 14%. This accounts for a capital loss of 34% as his own capital of 600.000 DKK from the time of purchase has now turned to a negative capital of 300.000 DKK.

If the owner-occupier, in the case of appreciation of house prices, uses the same strategy to withdraw equity from his investment as illustrated in the case of 100% leverage funding the amount possible to withdraw increases significantly from 120.000 DKK to 720.000 DKK or by 600.000 DKK (the same assumptions applies as before regarding transaction costs and fees). If prices fall again by 30% the total leverage is now 114%.

The LTV and the equity position			
0% EQUITY - 100% LEVERAGE			
	Time 0	30 % appreciation	30 % depreciation
Loan to value ratio	100%	77%	143%
Equity position	0%	23%	-43%
20% EQUITY - 80% LEVERAGE			
	Time 0	30 % appreciation	30 % depreciation
Loan to value ratio	80%	62%	114%
Equity position	20%	38%	-14%
50% EQUITY - 50% LEVERAGE			
	Time 0	30 % appreciation	30 % depreciation
Loan to value ratio	50%	38%	71%
Equity position	50%	62%	29%
100% EQUITY - 0% LEVERAGE			
	Time 0	30 % appreciation	30 % depreciation
Loan to value ratio	0%	0%	0%
Equity position	100%	100%	100%

Figure 13. Loan to value and the equity position.

Capital gain/loss			
In DKK all cases			
	Buying price	30 % appreciation	30 % depreciation
Capital gain/loss	3 million	900.000	-900.000
0% EQUITY - 100% LEVERAGE			
		30 % appreciation	30 % depreciation
Percentage change of equity		23%	-43%
20% EQUITY - 80% LEVERAGE			
		30 % appreciation	30 % depreciation
Percentage change of equity		18%	-34%
50% EQUITY - 50% LEVERAGE			
		30 % appreciation	30 % depreciation
Percentage change of equity		12%	-21%
100% EQUITY - 0% LEVERAGE			
		30 % appreciation	30 % depreciation
Percentage change of equity		0%	0%

Figure 14. Capital gains and losses.

7.1.3 50% equity – 50% leverage

In the four cases illustrated in this analysis a negative loan to value in the case of 30% depreciation is for the first time not observed when the borrower has 50% own capital at the time of buying⁴⁹. In this case the loan to value rises from 50% to 71% by the depreciation. In the same sense, equity falls from 50% to 29%. The capital loss is 21%. Returning to the temptation to withdraw equity from the investment in the case of appreciation, the amount possible to withdraw becomes much higher. A notice must be made that in this case the borrower, before the price changes, has only used 50% of the 80% maximum limit he is able to borrow according to the law. So he has the possibility to borrow the remaining 30% before appreciation ending up in the same situation as the one with the 20% equity. Whether he uses the maximum loan limit before prices began to rise or after he ends up in the same situation as the borrower with 20% own equity at the beginning, he has just increased his consumption by the extra 30% equity or 50% equity depending on which comparison is taken into a concern. In all cases the borrower ends up with a debt of total 3.120.000 DKK (see appendix 1).

7.1.4 100% equity – no leverage

When the investment is financed with 100% equity the purchase affordability is unchanged even though prices fluctuate up and down. The owner-occupier can realize a gain of 900.000 DKK in the case of appreciation and a loss by the same amount in the case of depreciation. For this investor the repayment

⁴⁹ The limit for all possible funding is set when the buyer has 30% own equity in the beginning. When prices fall by 30%, the loan to value rises from 70% to 100%.

affordability is not relevant and there is no risk of default. Even though, the risk of capital loss mentioned before makes the investment risky. This investor can at any time withdraw equity out of the investment and he therefore has the opportunity to increase his consumption. At the time he decides to withdraw equity by obtaining a mortgage loan the repayment affordability becomes relevant as in the other cases in the analysis. If he decides to do so, tax advantages of mortgage reduction discussed in 5.2.1 can be used even though his borrowing might have been used to increase consumption. Whether the withdrawal of equity in this case is motivated by the opportunity of the interest deduction as suggested by Se (2013) cannot be answered here.

7.2 Sensitivity analysis on the Repayment Affordability ratio

Details about the mortgage loans used in the analysis are shown in figure 15. A borrower applying for a one million DKK loan will most probably not receive the precise amount. This is due to different prices at the market in which the obligations are traded and cost related to different fees charged by the mortgage lender and official charges. Together those factors determine the principal of the loan⁵⁰.

	Fixed rate bond	Fixed rate bond, interest only ten years	Variable interest rate loan - F5	Variable interest rate loan, interest only ten years - S5
Amount borrowed	1.000.000 DKK	1.000.000 DKK	1.000.000 DKK	1.000.000 DKK
Coupon rate	3.50%	3.50%	1.42%	1.42%
Annual cost by percentage - ÅOP	4.50%	4.80%	2.40%	2.60%
Administration cost	0.65%	0.85%	0.75%	0.95%
Price	98.10	96.85	102.45	102.44
Amount paid to borrower	1.000.388 DKK	1.000.696 DKK	1.000.524 DKK	1.000.524 DKK
Principal	1.044.000 DKK	1.058.000 DKK	1.024.000 DKK	1.024.000 DKK
Taxes	30.50%	30.50%	30.50%	30.50%
Duration	30 years	30 years	30 years	30 years
Payments by year	4	4	4	4

Figure 15. The terms of the mortgages⁵¹.

7.2.1 The annual cost by percentage (ÅOP) and the administration cost

According to Danish law (Finanstilsynet, 2010), the annual cost by percentage (ÅOP=Årlig omkostnings procent) must be informed to Danish mortgage borrowers as this cost measures the real price for any given mortgage loan. The ÅOP cost consists of the coupon rate, the yield price (whether it is sold by premium or a

⁵⁰ The borrower can of course limit his amount borrowed by the amount preferred. In that case he has to have equity to cover a possible loss when the obligation is traded at the market and the costs by obtaining the loan.

⁵¹ Information on terms and prices retrieved from nordeakredit.dk 30.9.2013. Only available for customers of Nordea bank. Taxes are though adjusted to information from the Danish ministry of taxation, see chapter 7.2.2.

discount), the administration cost, and other fees charged by the mortgage lender⁵² as well as official charges (Nordea Kredit's consultant, 2013). When comparing the cost of borrowing between Danish mortgages lenders the annual cost by percentage (ÅOP) is the cost to consider as it compares the cost of different loan products, including the administration cost set by the lender in each case. The ÅOP cost is calculated in a percentage and is added on the coupon rate of the bond making it possible for the borrower to use it in the tax deduction on interest rates. The administration cost is one of the costs included in the ÅOP cost and the rate differs depending on a loan product chosen and the amount borrowed (Nordea bank, 2013a). Accurate calculations on the administration cost and a price list for different kind of fees and costs set by the mortgage lenders can be found in appendix 2. A notice must be taken to new prices for administration cost valid from January 2014. The price increases are most likely due to the BASEL III implementation discussed in 5.1.5 resulting in higher costs of borrowing in the form of increased interest rates.

7.2.2 Effective interest rate

The effective interest rate⁵³ refers to the interest rate the borrower pays taking all additional costs into a concern. As the annual cost by percentage (ÅOP) includes total cost of the amount borrowed this percentage can be used as the effective interest rate the borrower pays throughout the maturity of the loan. When using this method the principal of the mortgage is set at the value of 1.000.000 DKK. Another possible alternative is to calculate the effective interest rate by the coupon rate and the administration cost. In that case the principal after the yield price has been calculated is used to calculate the future payments (in the case of fixed rate bond the amount of 1.044.000 DKK would be used as a starting point). In the following calculations the former method will be used and the ÅOP/annual cost by percentage will be used as the effective interest rate for the calculations. The tax reduction will be taken into a concern as well lowering the effective interest rate in each case by 30.5% (Statistics Denmark, 2012, p 91). Because of a reform in the interest rate deduction allowance taxes will be lowered by one percentage per year in the years between 2014 and 2019, ending in 25.5% and held fast throughout the maturity of the loan (Skatteministeret, 2009a) and (Skatteministeret, 2009b).

7.2.3 The future interest rate calculation

Predicting the future is a difficult task and in economics and finance forecasts about the future have great impacts on the results, not at least when the future results are clear and a comparison on the prediction and the actual conclusion is possible. However, predictions are made in almost every field of the economic

⁵² The risk premium is included here.

⁵³ The effective interest rate can also refer to the investor at the market. In that case it is also known as yield to maturity, market interest rate or the internal rate of return.

and financial area where analysts and investors try to beat the market in the hope for a profit. There are several methods available when predicting the future interest rate. Some say that the only way to predict about the future is to look at the past and in that case experience from the past is used to predict the future. Other predictions available are the use of a binominal interest rate model and the Monte Carlo simulation. The method used in this thesis to predict the future interest rate is the forward rate calculation. The calculation of forward rates is a prediction of market expectation by extrapolating selected benchmark, usually spot rates or government bonds. The calculation of forward rates is made by building the zero-coupon yield curve by the following formula:

$$r_{t1,t2} = ((1+r_2)^{d2}/(1+r_1)^{d1})^{1/d2-d1} - 1$$

The zero-coupon yield curve is created by the calculated spots for each period. Those spots are then used to calculate the future interest rate for each interest rate on the yield curve. The following formula is used in the calculation:

$$(1+r_1)^{d1}(1+r_{t1,t2})^{d2-d1} = (1+r_2)^{d2}$$

The future interest rates calculated here are the risk free rates at the market so the risk premium and additional cost set by the lender are not included. The interest rate, after the risk premium has been added, is referred to as the effective interest rates. In this analyze the risk premium is calculated by the difference between the interest rate of the zero coupon bond for a five year calculation and the interest rate offered to the borrower⁵⁴. This difference is used as a risk premium on the future interest rate calculations. Figure 16 illustrates the forward rate calculations (for further information see appendix 3):

⁵⁴ Information regarding risk premium from the central bank to the mortgage lenders are not accessible for the public and risk premium set by the mortgage lender is complicated and difficult to get access to.

	t=0	t=5	t=10	t=15	t=20	t=25
DKK GOV spot rates	1.08%	3.23%	3.66%	3.37%	3.08%	2.88%
F5 coupon rate	1.42%	na	na	na	na	na
F5 ÅOP	2.40%	na	na	na	na	na
Risk premium	1.32%	1.32%	1.32%	1.32%	1.32%	1.32%
F5 effective interest rate	2.40%	4.55%	4.98%	4.69%	4.40%	4.20%
S5 coupon rate	1.42%	na	na	na	na	na
S5 ÅOP	2.60%	na	na	na	na	na
Risk premium	1.52%	1.52%	1.52%	1.52%	1.52%	1.52%
S5 effective interest rate	2.60%	4.75%	5.18%	4.89%	4.60%	4.40%

Figure 16. Effective interest rate.

Another option to calculate a benchmark for the future interest rate is to select bonds available at the market⁵⁵ and calculate the yield curve from information about yield and maturity within each bond (see appendix 3 for the test of the method for government bonds).

The forward rate calculation to predict the future interest rate is chosen after a consultation with several agents from different banks and lending institution⁵⁶. The method used in this project is the same as used by analytics when structuring mortgage loan calculations. It then seems relevant to use the same methods as in the calculations from the mortgage lenders to get the best approach to the borrower's future payments as well and to adjust the sensitivity analyze to the reality in the best possible way. The selection of method to calculate the future rates in order to predict the future interest curve is not the most relevant in this thesis. The relevance here is to show how the affordability ratios are affected by changes in interest rates not how accurate those calculations are.

7.2.3.1 The upward trend in the interest rate calculation

In this project the interest rate forecast is upwards through the lending period, with a small downturn in the end of the period. It is not unusual that the interest rate fluctuates over a period but in the reality those fluctuations can be upward and downward. The assumption for the upward trend throughout the lending period is made by two reasons⁵⁷. First, Danish interest rates are now at historical minimum and Danish obligations were sold with negative interest rates for the first time in the history in 2012. There is a common believe that that trend cannot be continued. Second, this thesis is about the risk and leverage the

⁵⁵ <http://www.nasdaqomxnordic.com/bonds/denmark>

⁵⁶ The author of this thesis contacted among others the National bank of Denmark, which data in the forward calculation is retrieved from, as well as other bank institutions in Denmark and abroad.

⁵⁷ The forward rate calculations predict the upward trend throughout the lending period. One might question why the trend is only upward and here the prediction is accepted because of the following explanations.

potential borrower is exposed to when borrowing. The interest rate risk can only be actual for the borrower if the interest rate rises.

7.2.3.2 The monetary policy and the upward trend

The monetary policy used by monetary authorities in Denmark and many other countries is a policy which uses interest rate to control economic growth and stability. When the economy is healthy where people and businesses are using money, interest rates are normally at higher level in order to control the consumption and to avoid the case of inflation or hyperinflation. In the same way, when the economy is weakened or in a crisis and people are saving money by decreasing consumption, interest rates are set lower in attempt to increase consumption and economic growth again. If the evolution of private consumption, as described in chapter 6.2, continues where people increase their consumption and consequently the economy recovers from the current crisis, the forecast on higher interest rate made in this thesis is very likely to be. In the case of upturn in the economy, the government is likely to use the monetary policy to hold back people's consumption and spending. As mentioned before, higher interest rate will slow down the consumption and spending. Again, as one of the thesis' main topics is to highlight the risk, the prediction of the opposite is not appropriate.

7.2.4 Debt-service-to-income ratio/Repayments

The debt-service-to-income ratio, the repayment on the loan, is the total amount paid on the mortgage in each period. This repayment affordability is the most important measurement of the repayment measurements discussed in this chapter as it sums up the total amount of the mortgage repayment with all costs included. If the household is not able to meet this obligation the risk of foreclosure and involuntary sale is present. Repayments for the four loan types are shown in figure 17.

The bond with fixed interest rates has a payment of 12.876 DKK in the beginning and because of a reform in Danish interest deduction allowance in the coming years, where the deduction will be reduced from approximately one third of the interest paid to approximately one fourth⁵⁸, the payment increases by that percentage after 20 payments and becomes 13.247 DKK. As typical for annuity loans, repayments are fixed throughout the maturity of the loan in this case with a payment of 13.247 DKK in each quarter of the year. For the same mortgage loan type, but with interest-only payments for the first ten years, the payment in the first five years is 8.340 DKK increasing to 8.940 DKK after that time because of the tax reform. The borrower who decides for an interest-only loan for the first ten years enjoys a lower repayment burden by paying only interests and no payments on the principal in that period. After ten years the borrower has to

⁵⁸ By 2019 the mortgage rate tax deduction is down to 25.5%.

start paying installments as well and because he has just paid interest in the past ten years the principal is now divided on 20 years, but not 30 years as if he had started to pay installments in the beginning. For that reason the repayment burden increases from 8.940 DKK to 17.552 DKK per each repayment or by 34.448 DKK on annual basis. The increase per payment is 96.30%. The borrower has to adjust to almost double payment burden. The annual cost by percentage (ÅOP) set by the lender is, in addition, for this loan 0.30 points⁵⁹ higher than the loan where installments are paid from the beginning. This difference in cost is in the form of interest rate paid in each repayment.

For the variable interest rate loans the difference between payments in the first five years is 135%, whether the interest-only option is chosen for the first ten years or not. The borrower who chooses the interest-only mortgage pays 4.518 DKK while the one who chooses to pay installments as well pays 10.609 DKK in each quarter. After ten years, when installments begin on the interest-only loan the difference between the payment burden on the two loans falls to 36%. The payment burden on the interest-only mortgage is now 17.993 DKK while the payment burden on the mortgage where installments have been made from the beginning is 13.258 DKK. Both loans have now changed by the tax reform where the interest deduction was lowered after the first five years and two interest rate increases (after year five and ten). Like for the fixed rate bond the annual cost by percentage (ÅOP) is higher for the interest-only mortgage, here by 0.20 points.

⁵⁹ ÅOP on the loan with installments is 4.5% while the ÅOP on the interest-only loan is 4.8%.



Figure 17. Debt-service-to-income ratio/Repayments.

When considering the repayments on the variable interest rate loan with interest-only payments when installments begin the payment burden from the time where no installments were paid is increased by 298%. The payments are now approximately four times higher than when the loan was obtained. The increase in interest rate by 2.05% in the ten year period has influences here as well, but the difference is great even when looking at the increase without the increase in interests. The total change in payment burden from paying no installments in the first ten years and suddenly to begin paying installments is an increase by 9.144 DKK (when calculating from numbers after the tax reform when deduction is lowered down to 25.5% in 2019). This is an increase by 103%. The difference between the 298% difference calculated before and the 103% calculation show the influences of the tax deduction on the repayment. As in the case where the fixed interest rate loan is considered this increase is because the principal of the loan is now paid in 20 years instead of 30 years and therefore the payment burden of the installments are higher.

7.2.5 Installments

The installment represents the payment paid on the principal of the loan. In annuity loans payments are fixed making the proportion between interest payments and installments unequal throughout the maturity

of the loan. In the beginning the installment is much less than the interest payment. The installment is then increasing throughout the horizon of the loan exceeding the interest payment where approximately half of the loan horizon is left as seen in figure 18.



Figure 18. Evolution of installments.

As seen at the graph there is a fall in the installment amount after five years for the variable interest rate mortgage with installments from the beginning. This is due to the reform on the interest mortgage deduction and because the interest rate is set higher. Because the deduction allowance is lowered during the five years, higher interests are paid on the principal leading to lower payments directly to the principal. This applies to all loan types. For the variable interest rate loan, same effects can be seen each time the interest rate is set higher up. For both loans, where only interests are paid in the first ten years, first installments are made in the beginning of period 40. The increase seen on the graph is corresponding to the increase changes (in amount and percentage) discussed in the chapter on the repayment. The installments on the interest-only loans are higher than the installments on the other two loan types throughout the loan because the principal paid on 20 years instead of 30.

7.2.6 Interest-service-to-income ratio

The total interests paid on the loans through the maturity are different. After five years, interests increase in all cases because of the interest deduction reform. For the loans with variable interest rates the increase is also because the interest rate is set higher. In the reality fixed interest rates are usually higher than the variable interest rates because they are fixed through the whole maturity of the loan. The investor at the market has committed to this rate of return while those who adjust interest rates to the market fluctuation by former decided interval have the opportunities to set the rate up in case of an upward trend at the market. As seen in figure 20 the calculations do not follow this general rule indicating how difficult it is to predict the future and therefore to calculate payments and interests many years forward. The reason for this similarity is that the prediction of the variable interest rate used in the analysis is made by forward rate calculation based on fixed rates on government bond.

The results worth to take a look at here are the actual costs of lending returning to the ÅOP rate (the annual cost of percentage) showed in figure 19. The numbers listed in figure 19 are the costs set by the lender for each of the loan types analyzed. The ÅOP percentage cost is showed ignoring taxes while the numbers below is the interest amount paid in DKK for each of the loan type. Those numbers include the tax deduction and show the total cost of borrowing for all loan types. The ÅOP rate is highest for the fixed rate bond where no installments are paid in the first ten years. The cost is for that type of loan 4.8% (before tax deduction). For the same type of loan, but with installments from the beginning the cost is 4.5%. For the interest rate loans with variable interest rate the cost is 2.4% and 2.6% where the latter one is for the interest-only mortgage. The difference by 3% and 2%, respectively, is because of the interest review every five years for the variable interest rate loans.

Bond with fixed interest rates	Bond with fixed interest rates, "interest only" ten years	Variable interest rate loan	Variable interest rate loan, "interest only" ten years
ÅOP: 4.5%	ÅOP: 4.8%	ÅOP: 2.4%	ÅOP: 2.6%
582.995 DKK	754.546 DKK	514.046 DKK	685.026 DKK

Figure 19. Paid interests and costs.

The total cost of the loans show that the variable interest rate loan is cheaper than a bond with fixed interest rates. In addition when choosing only to pay interests for the first ten years the loan becomes more expensive. This is consistent to the lenders information's regarding the annual cost of percentage. By using the interest-only option the borrower pays on average 31% $((0.2943+0.3326)/2)$ more in interests and cost

than by paying installments from the start. Calculated in numbers the difference is 171.551 DKK and 170.980 DKK for the fixed rate bond and the variable interest rate loan respectively. The development on interest payments is showed in figure 20 and interest rate path can be seen in figure 21:

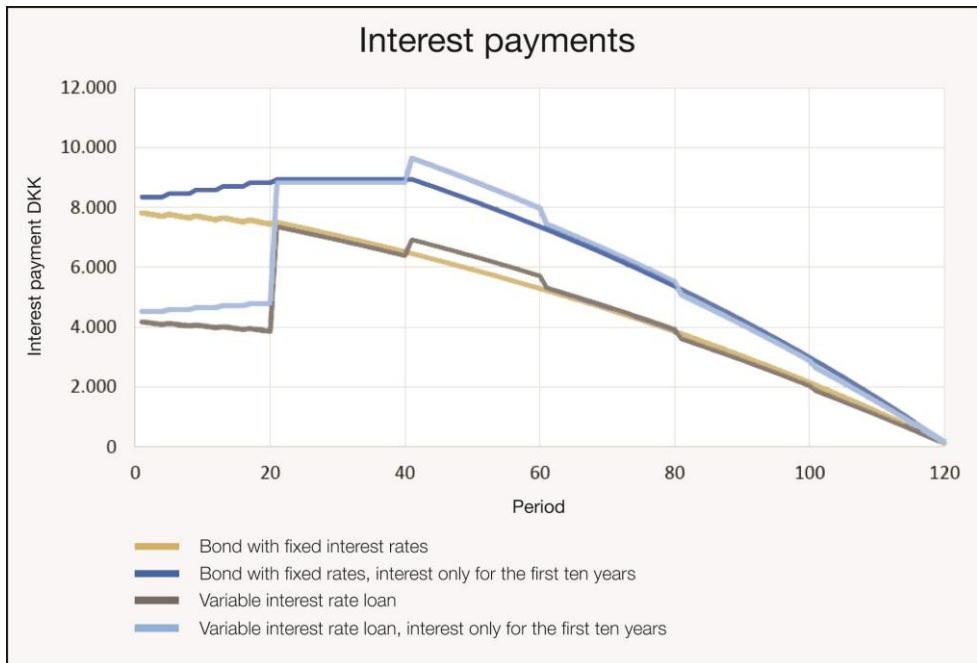


Figure 20. Development of interest payments.

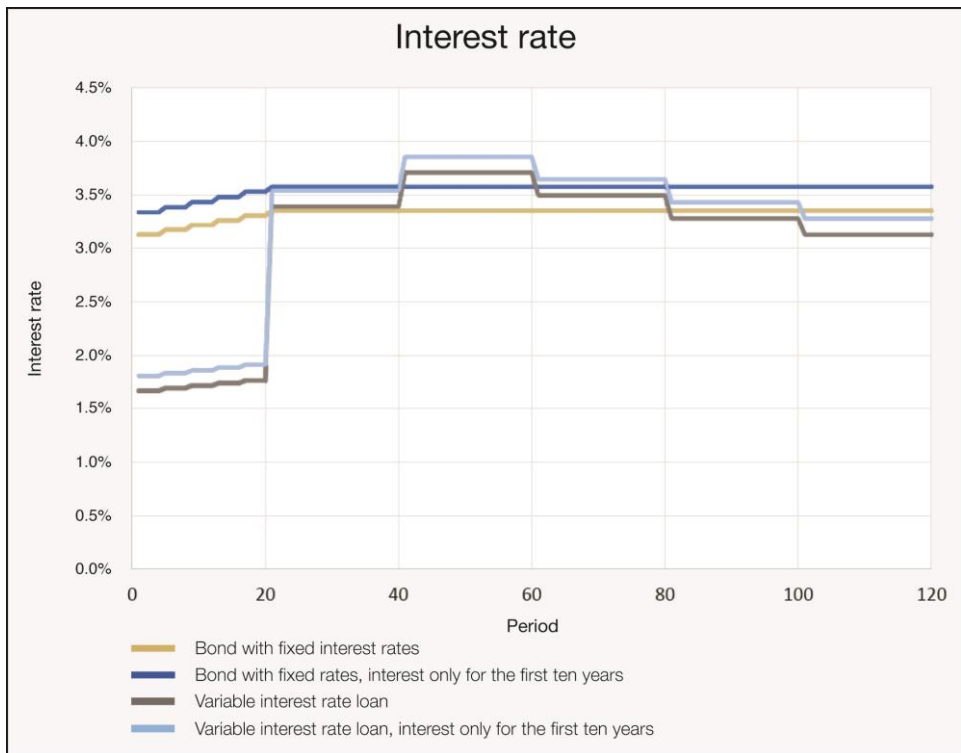


Figure 21. Interest rate development.

7.2.7 The development of principal

The development of the principal can be seen in figure 21.

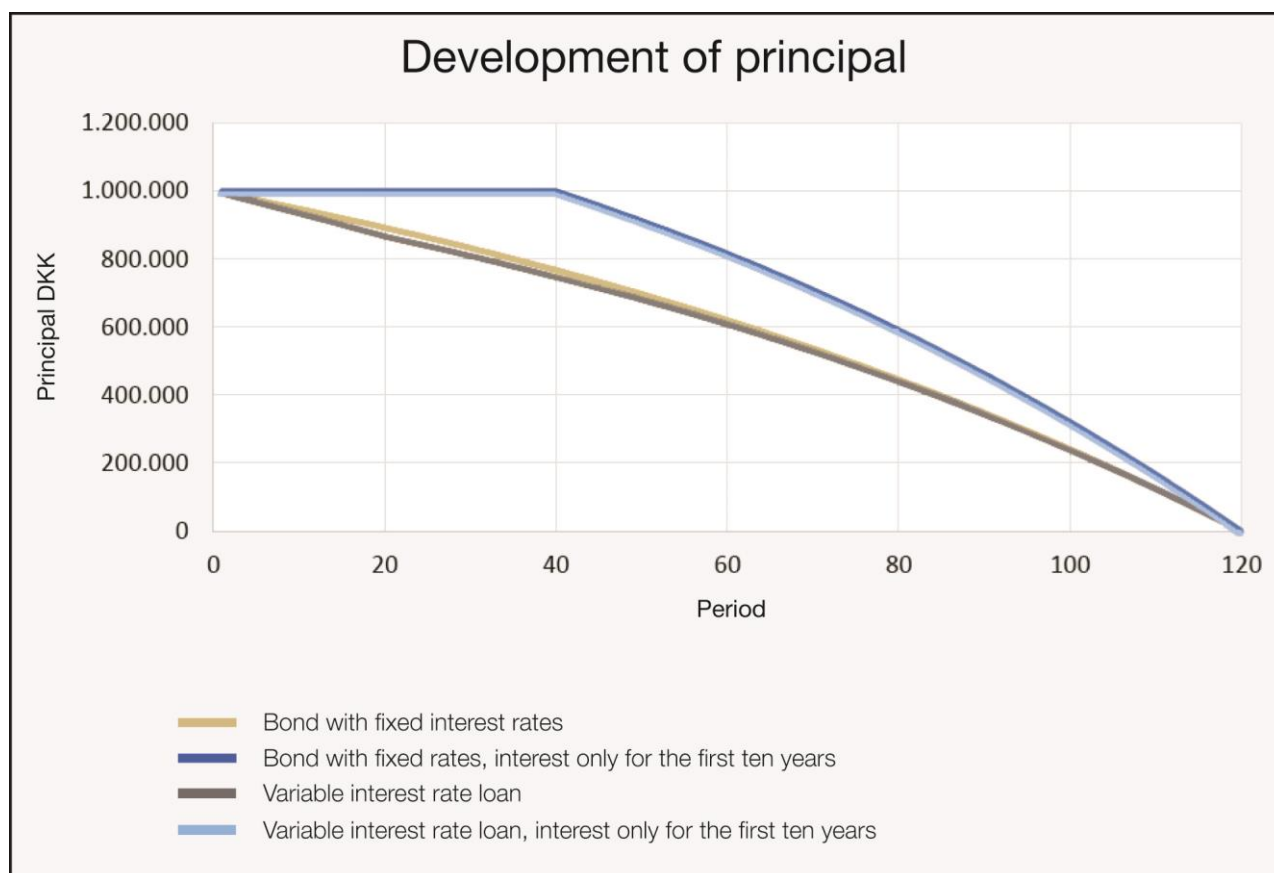


Figure 22. Development of principal.

The main thing to notice from the graph is that there are no payments made on the principal in the first ten years as to expect in the case of the two loan types with interest-only payments for the first ten years. It is worth to notice that no payments are made in one third of the horizon of the loans involved. Again the predicted interest rate influences the repayments on the variable loans, making them almost as high as the repayments on the fixed rates loans. This prediction makes the payments for the two interest-only loans almost equal. The same influences are seen in the case where installments are made from the beginning.

7.2.8 Installments and costs as a percentage of the repayment

Figures 23 and 24 show the division of installments and interests (and costs) within the repayments on the loan. The figures illustrate how much percentage of the total repayment goes directly to pay the principal of each loan. The interest payments are also an indicator of how much it actually cost to borrow. The main difference can be seen when comparing the bond with fixed interest rates and the variable interest loan (both with installments from the beginning). A borrower who chooses the bond with fixed interest rates

pays, in the beginning, 60% of his total payment in paying interests on the loan while the one who chooses variable interest loans pays 40% of his total payment in interests. After 25 payments the interest payments on the loans are almost equal and that is mainly because the interests are set higher in variable interest rate loan.

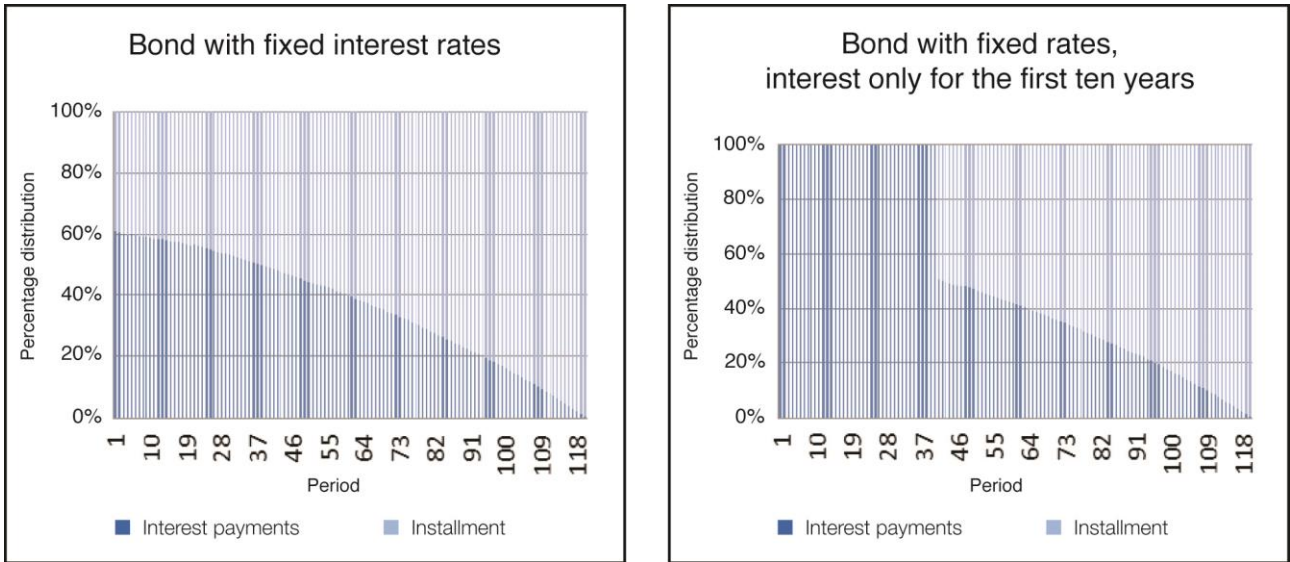


Figure 23. Fixed rate bond - distribution of installments and interest payments.

As illustrated before, all repayments on the interest-only loans goes into paying interests for the first ten years leading to no asset formation on these loans for the first ten years. After that time the division on installments and interest payments are similar.

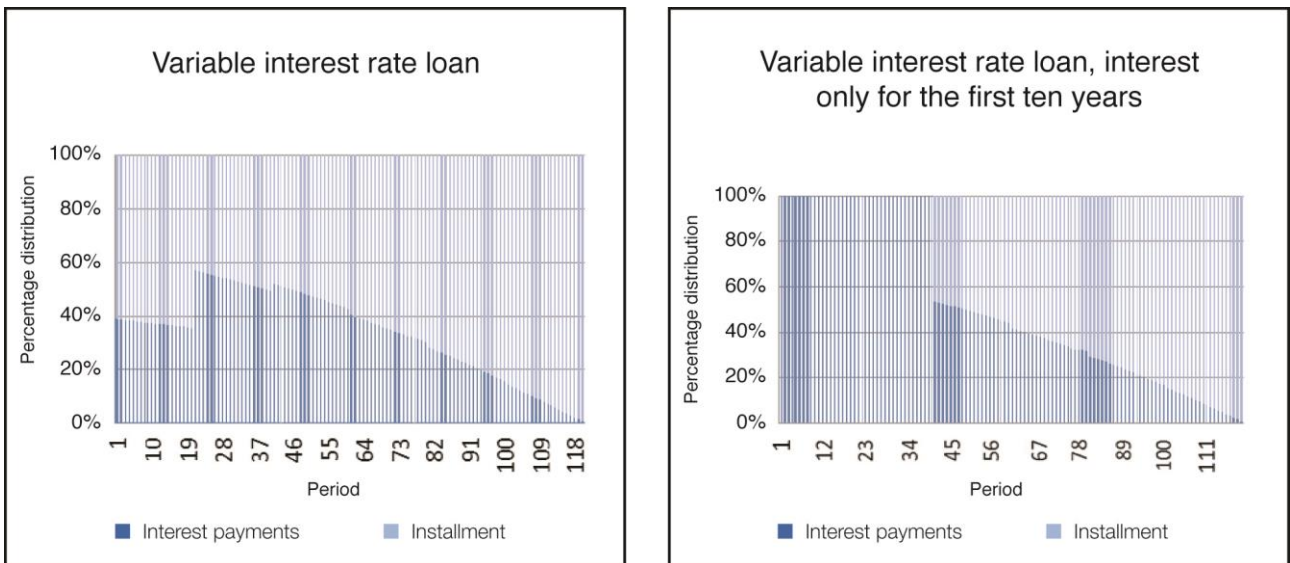


Figure 24. Variable interest rate loan - distribution of installments and interest payments.

When looking at the graphs above and the division of interests and installments the most apparent overall is how much fraction of the total payment actually goes to pay interests and costs on the loans. This total cost of borrowing varies from approximately 50-70% of the amount borrowed.

7.3 Results on the sensitivity analysis

In the purchase affordability analysis different equity possessions and loan-to-value ratios have been showed at the time of purchase. Effects on those possessions have also been illustrated in the cases of house price fluctuations. The influences on the loan-to-value ratio are significant in each case and the option to withdraw equity in the case of appreciation is possible even in the extreme case of no equity at the time of purchase. The results are increased leverage and a higher loan-to-value ratio, implementing increased risk for the borrower. In the cases where prices fall without any withdrawal of equity before the price reduction the risk is already present increasing the average loan-to-value ratio by 33% (taking the average of all four cases ending with an average of 0.32587). The risk is even higher when the possibility of equity withdrawal because of price appreciation is possible before another turnaround.

Even though the purchase affordability is the main topic in the first part of the analysis a proper interpretation of the results and the risk involved is not possible without the relevance of the repayment affordability. With any increased leverage the possibility of defaulting on the loan increases as the payment burden is positively correlated by increased leverage. The capital gains at each time of house appreciation are not real gains unless the investment is sold at the time when the appreciation becomes actual. If the gains are not realized by the action of selling the investment the risk of depreciation becomes relevant again. If the owner-occupier has refinanced his loan at the time of a house price upturn by taking a higher mortgage loan on the investment he is committed to a higher payment on his loan with the uncertainty of redeeming his former leverage possession. The risk of further house price depreciation is still present.

When comparing all loan types in the sensitivity analysis on the repayment affordability it becomes clear that even though the payment burden is easier in the beginning when considering the interest-only mortgages the severity is first realized when the payment of installments begins. In the meantime, while no payments on the principal are made, there is a risk for that the household has accustomed higher standard of living by increased consumption. Even if not, a payment burden of triple or even quadruple is for most households difficult to adjust to. In the case of variable interest rate loan, the risk of increases in interest rate is relevant as well making the changes even more volatile. Of course interest rates can also be lowered in the period for the advantages for the one choosing variable interest rates. In this case, the fixed rate bond becomes worse alternative as the interest rate is fixed throughout the maturity of the loan. The main

finding from the analysis on the repayment affordability is the risk of interest-only loans and the uncertainty regarding interest changes as well as additional costs of borrowing. The effects for the payment burden are very present and as a result the increased risk of default.

The main difference whether to choose a fixed rate mortgages or variable interest rate mortgages lies in ones expectations about future interest rates and his/hers risk aversion and if the borrower has the financial strength to adjust to different payments at different times in his payment horizon. When expectations of lowered interest rates in the future are present the borrower should consider a variable interest rate loan in order to minimize the repayments on his loan. Here the borrower must be able to react to changing payments throughout the maturity of the loan. At the time of low interest rate and where expectations of increased interest rates in the future are present, the borrower should consider changing his loan to a fixed rate mortgage loan in order to fix the low interest rates on his payments. This advice is not as easy to follow as to write down as there are many uncertainties regarding predictions and reality. The costs of refinancing must also be taken into a concern temptation to withdraw equity (if that's possible) in order to increase consumption. Even though the things mentioned above are important when considering risk and repayment of a mortgage, the possibility to choose interest-only loan for up to ten years must be considered the greatest risk factor for the borrower. Not only is the borrower confronted by higher administration costs when obtaining the loan, leading to higher interest rates to pay throughout the maturity of the loan. He is also confronted by the risk of increasing his consumption in the period of no installments payments making it more difficult (if possible at all) to begin payments on the principal after the interest-only period is over. When not assuming for increased consumption, the difference is already great as illustrated in the calculations. In Denmark, problems for the ones who chose the interest-only loans when they first where introduced in 2003 are already present now ten years later where the first payments are to be paid in the coming months in the fall of 2013. The mortgage lenders are already, together with the government, trying to find a solution for the many households that now face the fact not being able to pay the increased repayments on their mortgages. Whether it's because of increased consumption or the fact that those loans were deemed to fail from the beginning is not to be answered here.

A prediction on the future is difficult to make and therefore calculations for the future must be taken with prejudice due to uncertainty in the economic environment. Uncertainty regarding wages, price fluctuations, interest rates, financial stability, alternatives in loan products and changes in legislation and legal frames affecting ones affordability are the main reasons for discussing future calculations with care.

When looking back at figure 11, which shows that 51% of the Danish mortgage borrowers choose interest-only mortgages, and when those results are compared to the actual costs of borrowing and the risk involved it is easy to conclude that people are in general not concerned about the equity possession in their investments. It seems that people are more concerned about their repayment affordability than the purchase affordability, except at the time of buying when they are forced to take it into a consideration.

8. Conclusion

In this thesis the housing affordability and its problem area have been analyzed and described. Through the screening of literatures on the topic it has been shown that a single measurement on housing affordability does not exist making the topic difficult to analyze and generalize, especially through different markets and economies. In recent years, and especially in the current crisis, a new definition on the subject has been made where social housing and poverty become related to the housing affordability problem. As a result the topic does not only include various measurements depending on the researcher's object in each case but it also lacks the separation on whether it is used as a measurement on housing affordability in general or in the social housing and/or poverty segment. Results on housing affordability can in some cases be inconsistent depending on which measurements are chosen.

The housing affordability measurements can be problematic when using them in practice, both for the mortgage lenders and the borrowers. Proper measurements and tools to provide an effective counseling are not present today and potential homeowners are not able to decrease their risk by diversification as when they invest in others investments in the market. The providers of mortgage loans are in the strange position to sit on both sides of the table when lending money, setting the terms and conditions in order to control the leverage and risk taken by the borrower but at the same time watching over their own interests, trying to maximize their gains and minimize their risk. The moral hazard becomes relevant here as the possibility that the advice and approval given is not in the best interest for the borrower, but for the lender.

The possibility to increase consumption through increased leverage of one's housing is tempting for the borrower. Regulations and loosened credit constraints have, in the last 15-20 years, played a significant role in the access to funding a homeownership and the possibilities to withdraw equity from the investment. In this sense, the behavioral economics are considered a great influential part even though it is a difficult task, and sometimes impossible, to show clear evidence on the behavioral part of peoples consumption. When the market and official regulations in the legal frame signal the acceptance of no equity possession in the

home as well as no payments on the principal of the mortgage loan for up to ten years, the possibility for a change in the fundamentals of common thought and acceptance must be relevant.

The user cost, taxes and inflation become relevant when considering a homeownership and the housing affordability. The alternative to owning a house is renting it and in that sense it becomes relevant to look at the actual costs of owning compared to those of renting. The user cost of housing is affected by the payment burden of the mortgage loan when the home is financed by a mortgage. It has been argued for that in the case of appreciation of house prices the user cost for owner-occupiers is lowered but at the same time the purchase affordability for new homeowners is worsened. Taxes become relevant as they encourage leveraged finance of homeownership by the mortgage interest deduction, resulting in increased loan-to-value ratio. Different views are observed among academics regarding the influences of inflation on the housing affordability. Arguments are found to support that the inflation makes housing less affordable. Correspondingly, arguments are found supporting that the inflation lowers the user cost of owner-occupied housing making housing more affordable for current homeowners.

Two housing affordability measurements chosen for this project - the purchase affordability measurement and the repayment affordability measurement - have been connected to two theories of default, the equity theory of default and the ability to pay theory of default. Together the affordability measurements and theories have been used as a guide in a sensitivity analysis on different equity and debt possessions when buying a house and to forecast the repayment burden for the borrower undertaking the financial commitment of borrowing to finance a homeownership. There is an attempt to understand whether the borrower reacts to purchase affordability or the repayment affordability when considering his loan strategy and leverage, and whether he bases his default decisions on equity or repayments.

The main conclusions from the sensitivity analysis is that increased leverage is accompanied by increased risk for the borrower, both because the equity share is decreased resulting in worsened purchase affordability as the loan-to-value ratio becomes higher and because of worsened repayment affordability because of increased payment burden. At the same time increased leverage, when access to funding is easier, results in better purchase affordability as it becomes easier for new homeowners to enter the market. Even though the presence of risk is more observable within the homebuyers who borrow, the risk of homeownership is also present among those who have 100% equity at the time of the purchase. The risk for house price downturn is relevant here as well as the temptation to withdraw equity from the investment making the purchase affordability and the repayment affordability relevant. Another risk factor relevant for homebuyers is the risk one undertakes when investing in a single investment, not being able to diversify risk by choosing a portfolio with different investments.

The risk one takes when deciding on which mortgage loan to choose is also relevant. By taking an interest-only mortgage loan the buyer delays his payments on the principal of the loan and has the opportunity to increase his consumption while not paying any installments. The risk taken here is not realized until payments on the principal become real as the household now has to adjust to up to four times higher payments than it is used to and in addition has to decrease its consumption greatly if it has adopted increased consumption in the period of interest-only payments.

The Danish homeowners prefer mortgage loans with no payment made on the principal as those loans are the majority of the loans obtained at the Danish mortgage market in the last ten years. Danish households are the most indebted households worldwide and the increase in equity withdrawal has been rising since the introduction of refinancing and the restructure of the mortgage loan system in the period from 1970 until 1992-3. The mortgage lenders have a major role in mortgage counseling and decision making when the borrower obtains a mortgage loan. The legal framework is also relevant here as limits on maximum leverage are set by the authorities and the monetary policies are used to control the consumption and availability of funding.

It is concluded that the decision made by the borrower in the housing market and how he finance his housing consumption is under the influences of regulation and loosened credit restrictions and that the framework set by authorities and mortgage lenders affects people's minds in knowing which leverage is appropriate and acceptable. It is clear that Danish homeowners, in general, obtain the maximum leverage possible making the purchase affordability, the loan-to-value ratio, less relevant and the repayment affordability more important. Less concern seems to be about the equity possession in the investment than the repayment affordability making the ability to pay theory of default more important for the Danish borrowers. The increased consumption parallel to increased house prices in the years up to the crisis shows evidence that people's minds seem to be satisfied with increased leverage as long as consumption can be increased and repayments on their mortgages can be served. The increased risk followed by increased housing leverage seems to have been underestimated both by the lending institutions and by the borrowers. This is highly supported by the fact that now ten years after the first interest-only loans were available in Denmark, first payments on the principal are due and authorities and lending institutions are finding solutions for the many households not able to meet the increased financial burden they now are facing.

The International Monetary Fund states in their recent report (2013, p. 13) that household debt in Denmark has grown rapidly in the last decade and that this growth has mainly been driven by rising house prices and affordable access to credit. Authorities are already starting to address policies to reduce these high prices

and debt by limits on the loan-to-value ratio and by lowering the interest deductibility allowance. This action is a clear signal that authorities are aware of the influences prior legislation and loosened credit constraints have had on borrowers' actions and incentives to higher leverage. At the same time Danish consumers and borrowers are optimistic and believe that house prices can escalate further. It is clear that legislation and legal frames influence the actions of the people in the economy. How long it will take for Danish homeowners to realize and adopt a different way of thinking regarding the housing affordability problem, its leverage and risk, is impossible to predict.

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10. Appendices

Appendix 1

Calculations for house price fluctuations in 7.1.1 - 7.1.3

0% equity and 100% leverage			
	Price at time 0	30% appreciation	New loan available
Price	3.000.000	3.900.000	
Equity	0		
Mortgage, t=0	3.000.000		
LTV	100%	0,769230769	
Max loan	80%	0,8	
Difference		0,030769231	120.000
Final debt	3.120.000		
30% Depreciation	3.000.000		
Final LTV	104%		

20% equity and 80% leverage			
	Price at time 0	30% appreciation	New loan available
Price	3.000.000	3.900.000	
Equity	600.000		
Mortgage, t=0	2.400.000		
LTV	80%	0,615384615	
Max loan	80%	0,8	
Difference		0,184615385	720.000
Final debt	3.120.000		
30% Depreciation	3.000.000		
Final LTV	104%		

50% equity and 80% leverage			
	Price at time 0	30% appreciation	New loan available
Price	3.000.000	3.900.000	
Equity	1.500.000		
Mortgage, t=0	1.500.000		
LTV	50%	0,384615385	
Max loan	80%	0,8	
Difference		0,415384615	1.620.000
Final debt	3.120.000		
30% Depreciation	3.000.000		
Final LTV	104%		

Appendix 2

Nordea Kredit prislister

– gældende fra 1. januar 2013

Omkostninger ved låneoptagelse	Lån i danske kroner	Lån i euro
Lånesagsgebyr for lån i boliger og fritidshuse	2.500 kr.	335 euro
Lånesagsgebyr for lån i erhvervs- og landbrugsejendomme	5.000 kr.	670 euro
Ændring af lånetilbud, pr. tilbud	500 kr.	67 euro
Stiftelsesprovision for lån i boliger og fritidshuse	0 pct.	0 pct.

Stiftelsesprovision for lån i erhvervs- og landbrugsejendomme

Nyt lån, beregnet af lånets hovedstol	1 pct. min. 4.000 kr. <i>(min. 537 euro)</i> Landbrug og andelsboliger dog min. 2.000 kr. <i>(min. 268 euro)</i>
Konvertering af realkreditlån	0 pct. af lånets hovedstol

Kurtage

Kursværdi < 200.000 kr. Kursværdi < 26.875 euro	0,3 pct. af kursværdi min. 175 kr., maks. 300 kr. <i>(min. 23 euro, maks. 40 euro)</i>
200.000 kr. < kursværdi > 3.000.000 kr. 26.875 euro < kursværdi > 403.140 euro	0,15 pct. af kursværdi maks. 3.000 kr. <i>(maks. 403 euro)</i>
Kursværdi > 3.000.000 kr. Kursværdi > 403.140 euro	0,10 pct. af kursværdi

Kursskæring

Refinansiering af rentetilpasningslån	0,20 kurspoint
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Øvrige gebyrer

	Lån i danske kroner	Lån i euro
Gældsøvertagelse, pr. ejendom, privat	2.500 kr.	2.500 kr.
Gældsøvertagelse, pr. ejendom, erhverv	5.000 kr.	5.000 kr.
Relaksation, pr. ejendom pr. gang, privat	2.500 kr.	2.500 kr.
Relaksation, pr. ejendom pr. gang, erhverv	5.000 kr.	5.000 kr.
Opdeling af eksisterende lån, pr. lån	1.500 kr.	1.500 kr.
Ændring af refinansieringsfrekvens eller forkortelse af aftalt afdragsfri periode, pr. lån	500 kr.	500 kr.
Etablering eller forlængelse af afdragsfri periode ved refinansiering af rentetilpasningslån, pr. lån	2.500 kr.	2.500 kr.
Ekstra udskrivning - fx kopi af årsopgørelse, pr. stk.	200 kr.	200 kr.
Obligationsoverførsel til VP med håndpanterklæring, pr. lån	750 kr.	750 kr.
Ændring af eksisterende pantebrev, pr. stk.	750 kr.	750 kr.
Erindringsbrev eller overgivelse til inkasso, pr. stk.	100 kr.	13 euro
Henstandsbevilling, pr. lån	200 kr.	27 euro
Behandling og ændring af deponering, tilbageholdelse eller garanti	500 kr.	67 euro
Notering af transport, pr. notering	200 kr.	27 euro
Notering af kurskontrakt, pr. notering	500 kr.	67 euro
Indfrielses- eller nedbringelsestilbud, pr. lån	200 kr.	27 euro
Indfrielse eller nedbringelse, pr. lån	750 kr.	101 euro

Priser/gebyrer i euro er vejledende og kan ændres uden varsel, hvis eurokursen ændrer sig i forhold til danske kroner.

Nordea Kredit – årlige bidrag på nye lån i ejerboliger og fritidshuse

(Gælder fra 1. januar 2013)

Helårsbolig belåningsgrad	Fast rente med afvikling	Fast rente, afdragsfrihed	F1-F2 med afvikling	S1-S2 med afdragsfrihed	F3-F5 med afvikling	S3-S5 med afdragsfrihed
0 - 40 pct.	0,3500	0,4000	0,4500	0,5000	0,4000	0,4500
40 - 60 pct.	0,8000	1,0000	1,0500	1,2500	0,9250	1,1250
60 - 80 pct.	1,1000	1,6000	1,4500	1,9500	1,2750	1,7750
0 - 80 pct.	0,6500	0,8500	0,8500	1,0500	0,7500	0,9500

Fritidsbolig belåningsgrad	Fast rente med afvikling	Fast rente, afdragsfrihed	F1-F2 med afvikling	S1-S2 med afdragsfrihed	F3-F5 med afvikling	S3-S5 med afdragsfrihed
0 - 30 pct.	0,3500	0,4000	0,4500	0,5000	0,4000	0,4500
30-60 pct.	0,8000	1,0000	1,0500	1,2500	0,9250	1,1250
0 - 60 pct.	0,5750	0,7000	0,7500	0,8750	0,6625	0,7875

Grunde belåningsgrad	Fast rente med afvikling	Fast rente, afdragsfrihed	F1-F2 med afvikling	S1-S2 med afdragsfrihed	F3-F5 med afvikling	S3-S5 med afdragsfrihed
0 - 40 pct.	0,3500	0,4000	0,4500	0,5000	0,4000	0,4500

Bidragssatsen på dit lån afhænger af ejendommens belåningsværdi og belåningsgrad. Nedenfor kan du se et beregningseksempel.

Beregningseksempel

Lånetype	Fast rente, afdragsfrihed
Ejendomstype	Helårsbolig
Belåningsværdi	1.735.000
Lån, kursværdi	1.257.325
Belåningsprocent	72,47 $(1.257.325 / 1.735.000) * 100$

Interval	Lån	Sats	Beløb
0 - 40 pct. $(1.735.000 * 40 \text{ pct.})$	694.000	0,4000	2.776,00
40 - 60 pct. $(1.735.000 * (60 - 40))$	347.000	1,0000	3.470,00
60 - 80 pct. $(1.257.325 - 694.000 - 347.000)$	216.325	1,6000	3.461,20
I alt	1.257.325		9.707,20

Bidragssats $(9.707,02 / 1.257.325) * 100$

0,7721

Omlægning af lån

Bidragssatsen på det nuværende lån fortsætter som udgangspunkt uændret på det nye lån. Skifter du lånetype ændres bidragssatsen dog til den sats der gælder for den valgte lånetype.

Forhøjer du lånet med mere end 100.000 kr. eller vælger du afdragsfrihed i mere end 3 år beregnes bidragssats på ny.

Nordea Kredit Realkreditaktieselskab

Trommesalen 4, Postboks 850, 0900 København C
www.nordea.dk

Nordea Kredit – årlige bidrag på nye lån i ejerboliger og fritidshuse

(Gælder fra 1. januar 2014)

Helårsbolig belåningsgrad	Fast rente med afvikling	Fast rente, afdragsfrihed	F1-F2 med afvikling	S1-S2 med afdragsfrihed	Kort Rente og F3-F5 med afvikling	Kort Rente og S3-S5 med afdragsfrihed
0 - 40 pct.	0,3500	0,4500	0,5000	0,6000	0,4500	0,5500
40 - 60 pct.	0,8000	1,0500	1,1000	1,3500	0,9750	1,2250
60 - 80 pct.	1,1000	1,6500	1,5000	2,0500	1,3250	1,8750
0 - 80 pct.	0,6500	0,9000	0,9000	1,1500	0,8000	1,0500

Fritidsbolig belåningsgrad	Fast rente med afvikling	Fast rente, afdragsfrihed	F1-F2 med afvikling	S1-S2 med afdragsfrihed	F3-F5 med afvikling	S3-S5 med afdragsfrihed
0 - 30 pct.	0,3500	0,4500	0,5000	0,6000	0,4500	0,5500
30-60 pct.	0,8000	1,0500	1,1000	1,3500	0,9750	1,2250
0 - 60 pct.	0,5750	0,7500	0,8000	0,9750	0,7125	0,8875

Grunde belåningsgrad	Fast rente med afvikling	Fast rente, afdragsfrihed	F1-F2 med afvikling	S1-S2 med afdragsfrihed	F3-F5 med afvikling	S3-S5 med afdragsfrihed
0 - 40 pct.	0,3500	0,4500	0,5000	0,6000	0,4500	0,5500

Note: Renteloft prissættes som lån med fast rente.

Bidragssatsen på dit lån afhænger af ejendommens belåningsværdi og belåningsgrad. Nedenfor kan du se et beregningseksempel.

Beregningseksempel

Lånetype	Fast rente, afdragsfrihed		
Ejendomstype	Helårsbolig		
Belåningsværdi	1.735.000		
Lån, kursværdi	1.257.325		
Belåningsprocent	72,47	$(1.257.325 / 1.735.000) * 100$	

Interval	Lån	Sats	Beløb
0 – 40 pct. $(1.735.000 * 40 \text{ pct.})$	694.000	0,4500	3.123,00
40 - 60 pct. $(1.735.000 * (60 - 40))$	347.000	1,0500	3.643,50
60 - 80 pct. $(1.257.325 - 694.000 - 347.000)$	216.325	1,6500	3.569,36
I alt	1.257.325		10.335,86

Bidragssats $(10.335,86 / 1.257.325) * 100$	0,8222
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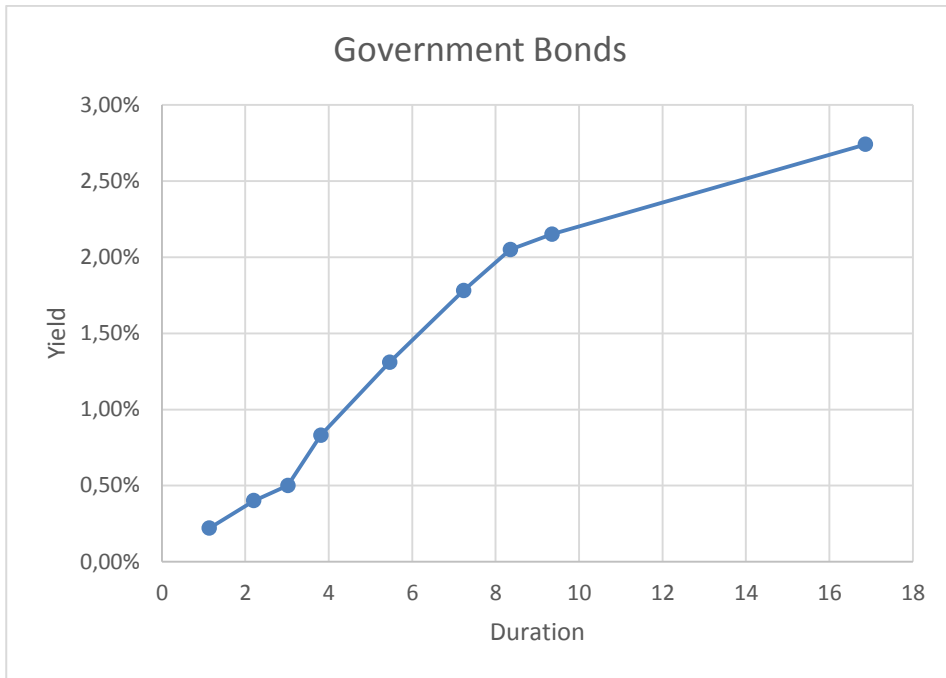
Omlægning af lån

Bidragssatsen på det nuværende lån fortsætter som udgangspunkt uændret på det nye lån. Skifter du lånetype ændres bidragssatsen dog til den sats der gælder for den valgte lånetype.

Forhøjer du lånet med mere end 100.000 kr. eller vælger du afdragsfrihed i mere end 3 år beregnes bidragssats på ny.

Nordea Kredit Realkreditaktieselskab

Trommesalen 4, Postboks 850, 0900 København C
www.nordea.dk



Test of 3 year forward rate:

	Duration	yield	forward	weights	
3 year i-r	3,0	0,50%	0,50%		
6 year i-r	6,0	1,5%	2,4%	0,69	0,31
9 year i-r	9,0	2,1%	3,4%	0,35	0,65

Appendix 4

Excel calculations for chapters 7.2.4 – 7.2.8

30 års OBLIGATIONSBLÅN NORDEA 30.9.2013

Med afdrag			
Beløb	1.000.000	Bidragssats	0,65%
Rente	3,50%	ÅOP	4,50%
Lånetid	30	Skattefr.dr.1-20	30,5-26,5%
Ydelser om året	4	120 Skattefr.dr.21-120	25,50%

Term	Variable rente	Rente	Afdrag	Ydelse	Restgæld
1	3,1%	7.819	5.057	12.876	994.943
2	3,1%	7.779	5.096	12.876	989.847
3	3,1%	7.739	5.136	12.876	984.711
4	3,1%	7.699	5.176	12.876	979.534
5	3,2%	7.770	5.179	12.949	974.355
6	3,2%	7.729	5.220	12.949	969.135
7	3,2%	7.688	5.262	12.949	963.873
8	3,2%	7.646	5.303	12.949	958.570
9	3,2%	7.714	5.309	13.023	953.261
10	3,2%	7.671	5.352	13.023	947.909

11	3,2%	7.628	5.395	13.023	942.514
12	3,2%	7.585	5.438	13.023	937.075
13	3,3%	7.650	5.447	13.098	931.628
14	3,3%	7.606	5.492	13.098	926.136
15	3,3%	7.561	5.537	13.098	920.600
16	3,3%	7.516	5.582	13.098	915.018
17	3,3%	7.578	5.594	13.172	909.424
18	3,3%	7.532	5.640	13.172	903.784
19	3,3%	7.485	5.687	13.172	898.097
20	3,3%	7.438	5.734	13.172	892.363
21	3,4%	7.497	5.750	13.247	886.613
22	3,4%	7.449	5.798	13.247	880.815
23	3,4%	7.401	5.846	13.247	874.969
24	3,4%	7.352	5.895	13.247	869.074
25	3,4%	7.302	5.945	13.247	863.129
26	3,4%	7.252	5.995	13.247	857.134
27	3,4%	7.202	6.045	13.247	851.089
28	3,4%	7.151	6.096	13.247	844.994
29	3,4%	7.100	6.147	13.247	838.847
30	3,4%	7.049	6.198	13.247	832.649
31	3,4%	6.997	6.250	13.247	826.399
32	3,4%	6.944	6.302	13.247	820.096
33	3,4%	6.892	6.355	13.247	813.741
34	3,4%	6.838	6.409	13.247	807.332
35	3,4%	6.785	6.462	13.247	800.870
36	3,4%	6.730	6.516	13.247	794.354

37	3,4%	6.676	6.571	13.247	787.783
38	3,4%	6.621	6.626	13.247	781.156
39	3,4%	6.565	6.682	13.247	774.475
40	3,4%	6.509	6.738	13.247	767.737
41	3,4%	6.453	6.794	13.247	760.943
42	3,4%	6.396	6.851	13.247	754.092
43	3,4%	6.338	6.909	13.247	747.183
44	3,4%	6.281	6.966	13.247	740.217
45	3,4%	6.222	7.025	13.247	733.192
46	3,4%	6.163	7.084	13.247	726.109
47	3,4%	6.104	7.143	13.247	718.966
48	3,4%	6.044	7.203	13.247	711.763
49	3,4%	5.984	7.263	13.247	704.499
50	3,4%	5.923	7.324	13.247	697.175
51	3,4%	5.861	7.386	13.247	689.790
52	3,4%	5.799	7.447	13.247	682.342
53	3,4%	5.737	7.510	13.247	674.832
54	3,4%	5.674	7.573	13.247	667.260
55	3,4%	5.611	7.636	13.247	659.623
56	3,4%	5.547	7.700	13.247	651.923
57	3,4%	5.482	7.765	13.247	644.158
58	3,4%	5.417	7.830	13.247	636.328
59	3,4%	5.351	7.896	13.247	628.433
60	3,4%	5.285	7.962	13.247	620.471
61	3,4%	5.219	8.028	13.247	612.443
62	3,4%	5.151	8.096	13.247	604.347

63	3,4%	5.083	8.164	13.247	596.183
64	3,4%	5.015	8.232	13.247	587.951
65	3,4%	4.946	8.301	13.247	579.651
66	3,4%	4.876	8.371	13.247	571.280
67	3,4%	4.806	8.441	13.247	562.839
68	3,4%	4.735	8.511	13.247	554.328
69	3,4%	4.664	8.583	13.247	545.745
70	3,4%	4.592	8.655	13.247	537.090
71	3,4%	4.520	8.727	13.247	528.363
72	3,4%	4.447	8.800	13.247	519.563
73	3,4%	4.373	8.874	13.247	510.689
74	3,4%	4.298	8.949	13.247	501.740
75	3,4%	4.223	9.024	13.247	492.716
76	3,4%	4.148	9.099	13.247	483.617
77	3,4%	4.072	9.175	13.247	474.442
78	3,4%	3.995	9.252	13.247	465.190
79	3,4%	3.917	9.330	13.247	455.860
80	3,4%	3.839	9.408	13.247	446.452
81	3,4%	3.760	9.487	13.247	436.965
82	3,4%	3.681	9.566	13.247	427.398
83	3,4%	3.600	9.647	13.247	417.752
84	3,4%	3.519	9.727	13.247	408.024
85	3,4%	3.438	9.809	13.247	398.215
86	3,4%	3.356	9.891	13.247	388.324
87	3,4%	3.273	9.974	13.247	378.350
88	3,4%	3.189	10.058	13.247	368.292

89	3,4%	3.105	10.142	13.247	358.150
90	3,4%	3.020	10.227	13.247	347.923
91	3,4%	2.934	10.313	13.247	337.611
92	3,4%	2.848	10.399	13.247	327.211
93	3,4%	2.761	10.486	13.247	316.725
94	3,4%	2.673	10.574	13.247	306.151
95	3,4%	2.584	10.663	13.247	295.488
96	3,4%	2.495	10.752	13.247	284.736
97	3,4%	2.405	10.842	13.247	273.894
98	3,4%	2.314	10.933	13.247	262.961
99	3,4%	2.222	11.025	13.247	251.936
100	3,4%	2.130	11.117	13.247	240.819
101	3,4%	2.037	11.210	13.247	229.608
102	3,4%	1.943	11.304	13.247	218.304
103	3,4%	1.848	11.399	13.247	206.905
104	3,4%	1.752	11.495	13.247	195.410
105	3,4%	1.656	11.591	13.247	183.819
106	3,4%	1.559	11.688	13.247	172.131
107	3,4%	1.461	11.786	13.247	160.345
108	3,4%	1.362	11.885	13.247	148.460
109	3,4%	1.262	11.984	13.247	136.476
110	3,4%	1.162	12.085	13.247	124.391
111	3,4%	1.061	12.186	13.247	112.205
112	3,4%	959	12.288	13.247	99.916
113	3,4%	856	12.391	13.247	87.525
114	3,4%	752	12.495	13.247	75.030

115	3,4%	647	12.600	13.247	62.430
116	3,4%	541	12.705	13.247	49.724
117	3,4%	435	12.812	13.247	36.912
118	3,4%	328	12.919	13.247	23.993
119	3,4%	219	13.028	13.247	10.965
120	3,4%	110	13.137	13.247	-2.171
Betalt		582.995	1.002.171	1.585.166	
		Rente	Afdrag	Ydelse	

Afdragsfrihed 10 år					30,5-
					Skattefr.dr.1-20 26,5%
					Skattefr.dr.21-
Beløb	1.000.000		Bidragssats	0,85%	120
Rente	3,50%		ÅOP	4,80%	25,50%
Lånetid	30			Måneder uden afdrag	40
Ydelser om året	4	120		Måneder m afdrag	80

	Term	Variable rente	Rente	Afdrag	Ydelse	Restgæld
Rentefr. 30,5%	1	3,3%	8.340	0	8.340	1.000.000
	2	3,3%	8.340	0	8.340	1.000.000
	3	3,3%	8.340	0	8.340	1.000.000
	4	3,3%	8.340	0	8.340	1.000.000
Rentefr. 29,5%	5	3,4%	8.460	0	8.460	1.000.000
	6	3,4%	8.460	0	8.460	1.000.000
	7	3,4%	8.460	0	8.460	1.000.000
	8	3,4%	8.460	0	8.460	1.000.000
Rentefr. 28,5%	9	3,4%	8.580	0	8.580	1.000.000
	10	3,4%	8.580	0	8.580	1.000.000
	11	3,4%	8.580	0	8.580	1.000.000
	12	3,4%	8.580	0	8.580	1.000.000
Rentefr.	13	3,5%	8.700	0	8.700	1.000.000

27,5%						
	14	3,5%	8.700	0	8.700	1.000.000
	15	3,5%	8.700	0	8.700	1.000.000
	16	3,5%	8.700	0	8.700	1.000.000
Rentefr. 26,5%	17	3,5%	8.820	0	8.820	1.000.000
	18	3,5%	8.820	0	8.820	1.000.000
	19	3,5%	8.820	0	8.820	1.000.000
	20	3,5%	8.820	0	8.820	1.000.000
Rentefr. 25,5%	21	3,6%	8.940	0	8.940	1.000.000
	22	3,6%	8.940	0	8.940	1.000.000
	23	3,6%	8.940	0	8.940	1.000.000
	24	3,6%	8.940	0	8.940	1.000.000
	25	3,6%	8.940	0	8.940	1.000.000
	26	3,6%	8.940	0	8.940	1.000.000
	27	3,6%	8.940	0	8.940	1.000.000
	28	3,6%	8.940	0	8.940	1.000.000
	29	3,6%	8.940	0	8.940	1.000.000
	30	3,6%	8.940	0	8.940	1.000.000
	31	3,6%	8.940	0	8.940	1.000.000
	32	3,6%	8.940	0	8.940	1.000.000
	33	3,6%	8.940	0	8.940	1.000.000
	34	3,6%	8.940	0	8.940	1.000.000
	35	3,6%	8.940	0	8.940	1.000.000
	36	3,6%	8.940	0	8.940	1.000.000
	37	3,6%	8.940	0	8.940	1.000.000
	38	3,6%	8.940	0	8.940	1.000.000
	39	3,6%	8.940	0	8.940	1.000.000
	40	3,6%	8.940	0	8.940	1.000.000
Afdrag begynder	1	3,6%	8.940	8.612	17.552	991388
	2	3,6%	8.863	8.689	17.552	982699
	3	3,6%	8.785	8.766	17.552	973933
	4	3,6%	8.707	8.845	17.552	965088
	5	3,6%	8.628	8.924	17.552	956164
	6	3,6%	8.548	9.004	17.552	947160
	7	3,6%	8.468	9.084	17.552	938076
	8	3,6%	8.386	9.165	17.552	928911
	9	3,6%	8.304	9.247	17.552	919663
	10	3,6%	8.222	9.330	17.552	910333
	11	3,6%	8.138	9.413	17.552	900920
	12	3,6%	8.054	9.498	17.552	891422
	13	3,6%	7.969	9.583	17.552	881840
	14	3,6%	7.884	9.668	17.552	872172

15	3,6%	7.797	9.755	17.552	862417
16	3,6%	7.710	9.842	17.552	852575
17	3,6%	7.622	9.930	17.552	842645
18	3,6%	7.533	10.019	17.552	832627
19	3,6%	7.444	10.108	17.552	822519
20	3,6%	7.353	10.199	17.552	812320
21	3,6%	7.262	10.290	17.552	802031
22	3,6%	7.170	10.382	17.552	791649
23	3,6%	7.077	10.474	17.552	781174
24	3,6%	6.984	10.568	17.552	770606
25	3,6%	6.889	10.663	17.552	759944
26	3,6%	6.794	10.758	17.552	749186
27	3,6%	6.698	10.854	17.552	738332
28	3,6%	6.601	10.951	17.552	727381
29	3,6%	6.503	11.049	17.552	716331
30	3,6%	6.404	11.148	17.552	705184
31	3,6%	6.304	11.247	17.552	693936
32	3,6%	6.204	11.348	17.552	682588
33	3,6%	6.102	11.449	17.552	671139
34	3,6%	6.000	11.552	17.552	659587
35	3,6%	5.897	11.655	17.552	647932
36	3,6%	5.793	11.759	17.552	636172
37	3,6%	5.687	11.864	17.552	624308
38	3,6%	5.581	11.971	17.552	612337
39	3,6%	5.474	12.078	17.552	600260
40	3,6%	5.366	12.185	17.552	588074
41	3,6%	5.257	12.294	17.552	575780
42	3,6%	5.147	12.404	17.552	563376
43	3,6%	5.037	12.515	17.552	550860
44	3,6%	4.925	12.627	17.552	538233
45	3,6%	4.812	12.740	17.552	525493
46	3,6%	4.698	12.854	17.552	512639
47	3,6%	4.583	12.969	17.552	499671
48	3,6%	4.467	13.085	17.552	486586
49	3,6%	4.350	13.202	17.552	473384
50	3,6%	4.232	13.320	17.552	460064
51	3,6%	4.113	13.439	17.552	446625
52	3,6%	3.993	13.559	17.552	433066
53	3,6%	3.872	13.680	17.552	419386
54	3,6%	3.749	13.803	17.552	405584
55	3,6%	3.626	13.926	17.552	391658
56	3,6%	3.501	14.050	17.552	377607
57	3,6%	3.376	14.176	17.552	363431
58	3,6%	3.249	14.303	17.552	349129

59	3,6%	3.121	14.431	17.552	334698
60	3,6%	2.992	14.560	17.552	320138
61	3,6%	2.862	14.690	17.552	305449
62	3,6%	2.731	14.821	17.552	290628
63	3,6%	2.598	14.954	17.552	275674
64	3,6%	2.465	15.087	17.552	260587
65	3,6%	2.330	15.222	17.552	245365
66	3,6%	2.194	15.358	17.552	230006
67	3,6%	2.056	15.496	17.552	214511
68	3,6%	1.918	15.634	17.552	198877
69	3,6%	1.778	15.774	17.552	183103
70	3,6%	1.637	15.915	17.552	167188
71	3,6%	1.495	16.057	17.552	151131
72	3,6%	1.351	16.201	17.552	134930
73	3,6%	1.206	16.346	17.552	118584
74	3,6%	1.060	16.492	17.552	102093
75	3,6%	913	16.639	17.552	85454
76	3,6%	764	16.788	17.552	68666
77	3,6%	614	16.938	17.552	51728
78	3,6%	462	17.089	17.552	34638
79	3,6%	310	17.242	17.552	17396
80	3,6%	156	17.396	17.552	0
Betalt		754.546	1.000.000	1.754.546	
		Rente	Afdrag	Ydelse	

RENTETILPASNINGSLÅN F5 og S5 NORDEAKREDIT 30.9.2013

Med afdrag					
Beløb	1.000.000		Bidragssats		0,75%
Rente	1,42%		ÅOP		2,40%
Lånetid	30	180	Skattefr.dr.1-20	30,5-26,5%	
Ydelse om			Skattefr.dr.21-		
året	4	120	120		25,50%

DKKGOV						
forw	0	5	10	15	20	25
m risiko	2,40%	4,55%	4,98%	4,69%	4,40%	4,20%
		25	20	15	10	5

Terms	Rente+Bidrag	Rente	Afdrag	Ydelse	Restgæld
1	1,67%	4.170	6.439	10.609	993.561
2	1,67%	4.143	6.465	10.609	987.096
3	1,67%	4.116	6.492	10.609	980.604
4	1,67%	4.089	6.519	10.609	974.084
5	1,69%	4.121	6.523	10.644	967.561
6	1,69%	4.093	6.551	10.644	961.011
7	1,69%	4.065	6.578	10.644	954.433
8	1,69%	4.038	6.606	10.644	947.827
9	1,72%	4.067	6.612	10.679	941.215
10	1,72%	4.039	6.640	10.679	934.575
11	1,72%	4.011	6.668	10.679	927.907
12	1,72%	3.982	6.697	10.679	921.209
13	1,74%	4.010	6.705	10.714	914.505
14	1,74%	3.981	6.734	10.714	907.771
15	1,74%	3.951	6.763	10.714	901.008
16	1,74%	3.922	6.793	10.714	894.215
17	1,76%	3.948	6.802	10.750	887.413
18	1,76%	3.918	6.832	10.750	880.581
19	1,76%	3.887	6.862	10.750	873.718
20	1,76%	3.857	6.893	10.750	866.825
1	3,39%	7.348	5.542	12.890	861.284
2	3,39%	7.301	5.589	12.890	855.695
3	3,39%	7.254	5.636	12.890	850.059
4	3,39%	7.206	5.684	12.890	844.375
5	3,39%	7.158	5.732	12.890	838.643
6	3,39%	7.109	5.781	12.890	832.862
7	3,39%	7.060	5.830	12.890	827.032
8	3,39%	7.011	5.879	12.890	821.153
9	3,39%	6.961	5.929	12.890	815.224
10	3,39%	6.911	5.979	12.890	809.245
11	3,39%	6.860	6.030	12.890	803.215
12	3,39%	6.809	6.081	12.890	797.134
13	3,39%	6.757	6.133	12.890	791.001
14	3,39%	6.705	6.185	12.890	784.817
15	3,39%	6.653	6.237	12.890	778.580
16	3,39%	6.600	6.290	12.890	772.290
17	3,39%	6.547	6.343	12.890	765.947
18	3,39%	6.493	6.397	12.890	759.550
19	3,39%	6.439	6.451	12.890	753.099
20	3,39%	6.384	6.506	12.890	746.593
1	3,71%	6.921	6.337	13.258	740.256
2	3,71%	6.862	6.396	13.258	733.860
3	3,71%	6.803	6.455	13.258	727.405

4	3,71%	6.743	6.515	13.258	720.890
5	3,71%	6.683	6.575	13.258	714.315
6	3,71%	6.622	6.636	13.258	707.679
7	3,71%	6.560	6.698	13.258	700.981
8	3,71%	6.498	6.760	13.258	694.221
9	3,71%	6.436	6.822	13.258	687.399
10	3,71%	6.372	6.886	13.258	680.513
11	3,71%	6.309	6.950	13.258	673.564
12	3,71%	6.244	7.014	13.258	666.550
13	3,71%	6.179	7.079	13.258	659.471
14	3,71%	6.114	7.145	13.258	652.326
15	3,71%	6.047	7.211	13.258	645.115
16	3,71%	5.980	7.278	13.258	637.837
17	3,71%	5.913	7.345	13.258	630.492
18	3,71%	5.845	7.413	13.258	623.079
19	3,71%	5.776	7.482	13.258	615.597
20	3,71%	5.707	7.551	13.258	608.046
1	3,50%	5.314	7.752	13.065	600.294
2	3,50%	5.246	7.819	13.065	592.474
3	3,50%	5.177	7.888	13.065	584.587
4	3,50%	5.109	7.957	13.065	576.630
5	3,50%	5.039	8.026	13.065	568.604
6	3,50%	4.969	8.096	13.065	560.508
7	3,50%	4.898	8.167	13.065	552.340
8	3,50%	4.827	8.238	13.065	544.102
9	3,50%	4.755	8.310	13.065	535.792
10	3,50%	4.682	8.383	13.065	527.408
11	3,50%	4.609	8.456	13.065	518.952
12	3,50%	4.535	8.530	13.065	510.422
13	3,50%	4.460	8.605	13.065	501.817
14	3,50%	4.385	8.680	13.065	493.137
15	3,50%	4.309	8.756	13.065	484.381
16	3,50%	4.233	8.832	13.065	475.549
17	3,50%	4.156	8.910	13.065	466.640
18	3,50%	4.078	8.987	13.065	457.652
19	3,50%	3.999	9.066	13.065	448.586
20	3,50%	3.920	9.145	13.065	439.441
1	3,28%	3.601	9.328	12.930	430.113
2	3,28%	3.525	9.405	12.930	420.708
3	3,28%	3.448	9.482	12.930	411.227
4	3,28%	3.370	9.559	12.930	401.668
5	3,28%	3.292	9.638	12.930	392.030
6	3,28%	3.213	9.717	12.930	382.313
7	3,28%	3.133	9.796	12.930	372.517

8	3,28%	3.053	9.877	12.930	362.640
9	3,28%	2.972	9.958	12.930	352.683
10	3,28%	2.890	10.039	12.930	342.644
11	3,28%	2.808	10.121	12.930	332.522
12	3,28%	2.725	10.204	12.930	322.318
13	3,28%	2.642	10.288	12.930	312.030
14	3,28%	2.557	10.372	12.930	301.658
15	3,28%	2.472	10.457	12.930	291.201
16	3,28%	2.387	10.543	12.930	280.658
17	3,28%	2.300	10.629	12.930	270.028
18	3,28%	2.213	10.716	12.930	259.312
19	3,28%	2.125	10.804	12.930	248.507
20	3,28%	2.037	10.893	12.930	237.615
1	3,13%	1.859	11.022	12.881	226.593
2	3,13%	1.773	11.108	12.881	215.485
3	3,13%	1.686	11.195	12.881	204.290
4	3,13%	1.598	11.283	12.881	193.007
5	3,13%	1.510	11.371	12.881	181.636
6	3,13%	1.421	11.460	12.881	170.176
7	3,13%	1.331	11.549	12.881	158.627
8	3,13%	1.241	11.640	12.881	146.987
9	3,13%	1.150	11.731	12.881	135.256
10	3,13%	1.058	11.823	12.881	123.434
11	3,13%	966	11.915	12.881	111.519
12	3,13%	872	12.008	12.881	99.510
13	3,13%	778	12.102	12.881	87.408
14	3,13%	684	12.197	12.881	75.211
15	3,13%	588	12.292	12.881	62.919
16	3,13%	492	12.388	12.881	50.531
17	3,13%	395	12.485	12.881	38.045
18	3,13%	298	12.583	12.881	25.462
19	3,13%	199	12.681	12.881	12.781
20	3,13%	100	12.781	12.881	0
Betalt		514.046	1.000.000	1.514.046	
	Rente		Afdrag	Ydelse	

Afdrag						
DKKGOV						
forw	0	5	10	15	20	25
Forward 5						
år	1,08%	3,23%	3,66%	3,37%	3,08%	2,88%
Rente	2,40%	4,55%	4,98%	4,69%	4,40%	4,20%
5 års STAT	1,08%					

Risiko	1,32%
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Afdragsfrihed 10 år

Beløb	1.000.000	Bidragssats	0,95%
Rente	1,42%	ÅOP	2,60%
Lånetid	30	180 Skattefr.dr.1-20	30,5-26,5%
Ydelser om året	4	120 120 Skattefr.dr.21-	25,50%

DKKGOV forw	0	5	10	15	20	25
m risiko	2,60%	4,75%	5,18%	4,89%	4,60%	4,40%
		25	20	15	10	5

Terms	Rente +Bidrag	Rente	Afdrag	Ydelse	Restgæld
1	1,81%	4.518		0	4.518 1.000.000
2	1,81%	4.518		0	4.518 1.000.000
3	1,81%	4.518		0	4.518 1.000.000
4	1,81%	4.518		0	4.518 1.000.000
5	1,83%	4.583		0	4.583 1.000.000
6	1,83%	4.583		0	4.583 1.000.000
7	1,83%	4.583		0	4.583 1.000.000
8	1,83%	4.583		0	4.583 1.000.000
9	1,86%	4.648		0	4.648 1.000.000
10	1,86%	4.648		0	4.648 1.000.000
11	1,86%	4.648		0	4.648 1.000.000
12	1,86%	4.648		0	4.648 1.000.000
13	1,89%	4.713		0	4.713 1.000.000
14	1,89%	4.713		0	4.713 1.000.000
15	1,89%	4.713		0	4.713 1.000.000
16	1,89%	4.713		0	4.713 1.000.000
17	1,91%	4.778		0	4.778 1.000.000
18	1,91%	4.778		0	4.778 1.000.000
19	1,91%	4.778		0	4.778 1.000.000
20	1,91%	4.778		0	4.778 1.000.000
21	3,54%	8.849		0	8.849 1.000.000
22	3,54%	8.849		0	8.849 1.000.000

23	3,54%	8.849	0	8.849	1.000.000
24	3,54%	8.849	0	8.849	1.000.000
25	3,54%	8.849	0	8.849	1.000.000
26	3,54%	8.849	0	8.849	1.000.000
27	3,54%	8.849	0	8.849	1.000.000
28	3,54%	8.849	0	8.849	1.000.000
29	3,54%	8.849	0	8.849	1.000.000
30	3,54%	8.849	0	8.849	1.000.000
31	3,54%	8.849	0	8.849	1.000.000
32	3,54%	8.849	0	8.849	1.000.000
33	3,54%	8.849	0	8.849	1.000.000
34	3,54%	8.849	0	8.849	1.000.000
35	3,54%	8.849	0	8.849	1.000.000
36	3,54%	8.849	0	8.849	1.000.000
37	3,54%	8.849	0	8.849	1.000.000
38	3,54%	8.849	0	8.849	1.000.000
39	3,54%	8.849	0	8.849	1.000.000
40	3,54%	8.849	0	8.849	1.000.000
1	3,86%	9.643	8.350	17.993	991.650
2	3,86%	9.562	8.430	17.993	983.220
3	3,86%	9.481	8.512	17.993	974.709
4	3,86%	9.399	8.594	17.993	966.115
5	3,86%	9.316	8.676	17.993	957.439
6	3,86%	9.232	8.760	17.993	948.678
7	3,86%	9.148	8.845	17.993	939.834
8	3,86%	9.063	8.930	17.993	930.904
9	3,86%	8.977	9.016	17.993	921.888
10	3,86%	8.890	9.103	17.993	912.785
11	3,86%	8.802	9.191	17.993	903.594
12	3,86%	8.713	9.279	17.993	894.315
13	3,86%	8.624	9.369	17.993	884.946
14	3,86%	8.533	9.459	17.993	875.487
15	3,86%	8.442	9.550	17.993	865.937
16	3,86%	8.350	9.642	17.993	856.294
17	3,86%	8.257	9.735	17.993	846.559
18	3,86%	8.163	9.829	17.993	836.729
19	3,86%	8.068	9.924	17.993	826.805
20	3,86%	7.973	10.020	17.993	816.786
1	3,64%	7.442	10.290	17.732	806.496
2	3,64%	7.348	10.384	17.732	796.112
3	3,64%	7.254	10.478	17.732	785.634
4	3,64%	7.158	10.574	17.732	775.060
5	3,64%	7.062	10.670	17.732	764.390
6	3,64%	6.964	10.767	17.732	753.623

7	3,64%	6.866	10.865	17.732	742.757
8	3,64%	6.767	10.964	17.732	731.793
9	3,64%	6.667	11.064	17.732	720.728
10	3,64%	6.567	11.165	17.732	709.563
11	3,64%	6.465	11.267	17.732	698.297
12	3,64%	6.362	11.369	17.732	686.927
13	3,64%	6.259	11.473	17.732	675.454
14	3,64%	6.154	11.578	17.732	663.876
15	3,64%	6.049	11.683	17.732	652.193
16	3,64%	5.942	11.790	17.732	640.404
17	3,64%	5.835	11.897	17.732	628.507
18	3,64%	5.726	12.005	17.732	616.501
19	3,64%	5.617	12.115	17.732	604.387
20	3,64%	5.507	12.225	17.732	592.162
1	3,43%	5.074	12.475	17.548	579.687
2	3,43%	4.967	12.581	17.548	567.106
3	3,43%	4.859	12.689	17.548	554.416
4	3,43%	4.750	12.798	17.548	541.618
5	3,43%	4.641	12.908	17.548	528.711
6	3,43%	4.530	13.018	17.548	515.693
7	3,43%	4.418	13.130	17.548	502.563
8	3,43%	4.306	13.242	17.548	489.321
9	3,43%	4.192	13.356	17.548	475.965
10	3,43%	4.078	13.470	17.548	462.495
11	3,43%	3.963	13.586	17.548	448.909
12	3,43%	3.846	13.702	17.548	435.207
13	3,43%	3.729	13.819	17.548	421.388
14	3,43%	3.610	13.938	17.548	407.450
15	3,43%	3.491	14.057	17.548	393.393
16	3,43%	3.371	14.178	17.548	379.215
17	3,43%	3.249	14.299	17.548	364.916
18	3,43%	3.127	14.422	17.548	350.495
19	3,43%	3.003	14.545	17.548	335.949
20	3,43%	2.878	14.670	17.548	321.280
1	3,28%	2.633	14.849	17.482	306.431
2	3,28%	2.511	14.971	17.482	291.460
3	3,28%	2.389	15.093	17.482	276.366
4	3,28%	2.265	15.217	17.482	261.149
5	3,28%	2.140	15.342	17.482	245.807
6	3,28%	2.014	15.468	17.482	230.340
7	3,28%	1.888	15.594	17.482	214.746
8	3,28%	1.760	15.722	17.482	199.023
9	3,28%	1.631	15.851	17.482	183.172
10	3,28%	1.501	15.981	17.482	167.192

11	3,28%	1.370	16.112	17.482	151.080
12	3,28%	1.238	16.244	17.482	134.836
13	3,28%	1.105	16.377	17.482	118.459
14	3,28%	971	16.511	17.482	101.948
15	3,28%	835	16.646	17.482	85.301
16	3,28%	699	16.783	17.482	68.518
17	3,28%	562	16.920	17.482	51.598
18	3,28%	423	17.059	17.482	34.539
19	3,28%	283	17.199	17.482	17.340
20	3,28%	142	17.340	17.482	0
Betalt		685.026	1.000.000	1.685.026	
		Rente	Afdrag	Ydelse	

Uden afdrag						
DKKGOV forw	0	5	10	15	20	25
Forward 5 år	1,08%	3,23%	3,66%	3,37%	3,08%	2,88%
Rente	2,60%	4,75%	5,18%	4,89%	4,60%	4,40%
5 års STAT	1,08%					
Risiko	1,52%					