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The Fear of Mortgage Banks for the Elimination of the Home Mortgage Interest Deductibility:

An investigation of the impact on the value of a Dutch mortgage portfolio.

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Preface and Acknowledgements

The first idea about writing a thesis on this topic came up by reading an article from the Federation of Dutch Home Owners (VEH). Before, the elimination of interest deductibility was only one of the topics in the electoral discussion. In the article of the VEH, for the first time, a banker touched upon the possible impact of the elimination for single households and furthermore for mortgage banks. Together with my knowledge about the risky lending practices of some mortgage banks in the recent years, this had to be an interesting topic of research.

The attention for the interest deduction on mortgages faded away with the elections of 2006, when the CDA became one of the important parties in the government. CDA has always opposed a possible elimination of the interest deductibility of mortgage payments.

But the last year, the impact of a house price decrease became visible by the extreme house price decreases in the US. Especially interesting for me were the risky lending practices in the US, something that had happened in a comparable way in the Netherlands in 2003-2007. We all know the devastating consequences this had on the financial performance and eventually even on the existence of various American banks. Via the UK, the trend of house price decreases reached the Dutch housing market. From July 2008 until June 2009, house prices decreased on average by 4.5%. Beyond the scope of this research but too interesting not to mention is the impact of the house prices on the total economy. In the US, something that began with the failure of some mortgagees on risky mortgage loans ended up as a worldwide economic crisis, impacting production, consumer confidence and household spending all over the world.

I am still surprised by something that started at such a low level of the society became of interest of all of us.

This thesis enabled me to combine my interests in taxation, banking and politics into a covering study. Especially the decisions I had to make in the quantative part of the research appealed to my valuation and statistical knowledge. I want to thank Dr. Smant for his supervision. He helped me to keep my attention on the research question and not to silt up in details. Furthermore, I want to thank Mr. Van der Wel for the helpful comments on the option valuation model. Last but not least, the Rabobank deserve a warm thanks for their support in collecting and eventually providing me the data. I experienced some difficulties in acquiring a data set of real mortgage data, but the Rabobank eventually enabled me to do the quantative part of the research.

Abstract

This thesis surveys the impact of the an elimination of the tax favorable treatment of mortgage costs on the value of a mortgage portfolio. According to the CPB, four methods of elimination or reduction exists from which one appears to be the most plausible. The expected change in house prices as a result of the tax change, influences the value of the mortgage to the bank.

This value is further dependent on the face value of the loan, the remaining interest payments, the remaining fixed rate period, the value of the option to default and the possibility of prepayment. The research of Charlier and Van Bussel (2003) is used to estimate the possibility of prepayment, while the option of default is valued according to the Black and Scholes (1972) framework. The valuation formulas are applied to a real mortgage portfolio of the Rabobank and the values are calculated with and without tax subsidization. By comparing both values we are able to provide insight into the value change of the mortgage portfolio to the bank.

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1. Introduction

It is already ten years ago that the electoral congress of the Dutch Labor Party[1] for the first time touched upon the possible (partial) elimination of the tax deductibility of mortgage interest payments in the Netherlands. The resistance of the leader of the party, Wim Kok, seems to be typical for the sensitiveness of the current discussion. Since that time, politicians debated about the pros and cons of this 'unfair way of subsidizing rich house owners'[2], but until now, none of them had the courage to drive his plans about a real elimination to the end.

The tax deductibility of interest payments on mortgages is founded in 1914 together with the introduction of the income tax as an instrument to encourage home ownership. A study of Glaeser and Shapiro (2002) showed that the quality of living is substantially higher in areas where people own their houses, compared to renting areas. Therefore, the increase of the percentage of homeowners seems to be a goal worth to achieve. By means of the tax subsidy, the government lowers the costs of housing to home owners, which is expected to increase the percentage of homeowners. But the theory seems to differ from the real world in the way that, compared to other countries without this kind of tax subsidy, the percentage of homeowners was relatively low in the Netherlands. As one of the drawbacks of the tax subsidization, house prices increased. Furthermore, mortgagees are encouraged to maximize the leverage their home financing by maximizing their mortgage loan. The ones who profit from the tax subsidy are mainly the more wealthy households which use the tax system to buy larger houses and attain higher mortgage loans. Less wealthy households have not found their way to home ownership yet and still rent the property. Regarding these findings, it is said that the current system unequally jeopardizes the wealthy households over the less wealthy ones. Mortgage banks profited widely from the excessive borrowing practices of the wealthy households. Interest revenues grew year after year and mortgage loans as a percentage of the total balance sheet of the lending sector increased.[3] Hereby, mortgage banks increased their exposure to house price changes. Since house prices were increasing, the value of the property as a guarantee for the loan was usually higher than the face value of the loan.

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[1] Boer, de, B, P. Lucardie, I. Noomen and G. Voerman, 1998, Overzicht van de partijpolitieke gebeurtenissen van het jaar 1998, Kroniek 1998, p. 64
[2] Vos, M.L. opinion statement on http://renteaftrek.eigenhuis.nl/Default.aspx?tabid=179
[3] European Mortgage Federation, Annual report 2006, June 2007, Brussels

Increasing house prices was another drawbacks of the tax subsidy of interest payments on mortgage loans. House values increased on average 71.4 percent over the last 10 years[4], making it difficult for young people to finance a house.

In the past two decades several countries undertook action to control the rapidly growing house prices which seemed to be directly caused by the tax subsidization. In Sweden and the UK, the governments decided to partly eliminate the tax subsidization of home ownership. Various researches predicted an serious economic downturn in those countries as a result of the deflation and the shrinking consumer confidence[5], but none of this became true.

Turning back to the Netherlands, recent studies conducted by the Central Planning Agency (CPB) showed the possible macro-economic effects of a (partial) elimination of the deduction of mortgage interest payments in the Netherlands.[6] The researches concentrated on 4 different scenarios of lowering or eliminating the tax subsidy on home ownership. For all four, the CPB expects households to reallocate their consumption patterns as a result of the sudden increase in housing costs. In order to maintain the same level of net housing costs, the total mortgage loan should decrease. This is expected to put pressure on house prices, which will decline eventually. Whereas these researches do not predict a collapse of the entire housing market, house prices will indeed fall by 4.5 to 14%. Furthermore, as suggested by Koning et al. (2006), the micro-economic consequences should not be forgotten. An increase in net interest rate, caused by the elimination of the deductibility, can affect the affordability of the interest payments on current outstanding mortgages for households with particular high interest-to-income ratios. If the process of reallocation is delayed, these households might come into trouble and, in the end, default on their mortgage.

Previously, when house prices were increasing and exceeded loan values, mortgage banks did not pay much attention to the risks attributed to the mortgage lending and the high mortgage amounts at their balance sheets. Other banks, pension funds and financial intermediaries buy the securitized packages of these loans and do not pay much attention to the risks of those packages either.

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[4] Kadaster, House value-index, June, 1999- June, 2009
[5] Hendershott and White (2000)
[6] Ewijk et al. (2006)

The Dutch Federation of Banks first warned for the exposure of mortgage banks to house prices in 2007. They also paid attention to the impact of a sudden change of the taxation of homeownership and expect that this could lead mortgage banks into serious problems.[7] Those problems might be caused by the inability for home owners to pay the higher net interest costs and will eventually lead to defaults. Together with a decreasing value of the collateral, this might force mortgage banks to write off serious amounts on defaulting mortgage borrowers.

This research focuses on the effects of an elimination of the deductibility of the mortgage interest payments for mortgage banks. The central question that this study tries to answer is:

What is the influence on value of the mortgage portfolio of a bank in the case that the tax deductibility of mortgage interest payments in the Netherlands is (partially) eliminated?

Previous literature, like the CPB-reports, elaborated on the impact of a possible tax change on important market variables like house prices and expenditures on housing. Those researches distinguish themselves because of their approach to the tax changes. They take the current political debate as the starting point of their investigation, while others just elaborate on the relation between the interest rate and house prices. On the other hand, we transfer the expected outcome of the tax change to the value of a mortgage portfolio. There exists maybe even more literature on the valuation of mortgages. Researches differ on the way they treat the options of prepayment and default and on assumptions they make on the distribution of certain variables. Most of the researches are purely focused on the techniques of the valuation and the estimation of significant variables, while this research applies the technique to a real mortgage portfolio. The impacts of a realistic scenario of the tax elimination are translated to the impacts for a bank which owns a particular mortgage portfolio. This combination has not been the topic of research before.

In order to answer the central question, chapter 2 investigates the current taxation of home ownership in the Netherlands. Also other countries are investigated in order to make a comparison between different countries. The cross-border comparison will help us to predict the consequences of a change in the tax system. Chapter 3 describes the current situation of the housing and mortgage market. This chapter sets the framework in which the change of the tax system should be evaluated. Special characteristics of the Dutch mortgage market are important

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[7] Dutch Federation of Banks, 2007, "Hypotheekrente: zekerheid voor lange termijn", www.nvb.nl

in setting the valuation framework. Particular attention is paid to the situation in the US. The combination of rising housing costs, caused by an increase in interest rates, and an increasing amount of subprime loans, caused serious problems to various mortgage banks and banks with large portfolios of securitized mortgage loans. This shows the sensitivity of the value of a mortgage to changes in housing costs.

A change of the tax system and the influence on mortgage values should be considered in the light of the current condition of the mortgage market and the lessons learned in the US. Chapter 4 elaborates the different scenarios the CPB drew for a new system of taxation. The chapter continues with a detailed description of one of the scenarios which is expected to be the most plausible one for implementation. Using the calculations of the CPB, the influence on house prices and real interest rates, is estimated. Chapter 5 describes the model used to value the mortgage portfolio. Specific attention is paid to the prepayment features of Dutch mortgages which differ from an ordinary mortgage contract. The mortgage contract is modeled as a loan with several option components in order to accurately value the possibilities of prepayment and default. The value of the loan to the lender depends, amongst others, on the variables of the interest rate and the house price. Chapter 6 gives a description of the data used to answer the central question. For this research, individual loan data is provided by the Rabobank. Chapter 7 presents the results of the valuation of the mortgage portfolio. The valuation model, described in chapter 5, is run to determine the value of each separate mortgage contract, both under the current taxation system and under the proposed new scenario. A scenario analysis is performed to facilitate a thorough understanding of the influence of the changing interest rates and house prices. Chapter 8 concludes with a comparison of the value of the portfolio under the current and the future tax system, also paying attention to the impact for the bank of this possible value change.

2. Taxation of home ownership

In order to achieve our goal of calculating the possible impact of a change of taxation of homeownership, we first investigate the current tax system related to home ownership and its incentives.

There are various topics under consideration when evaluating the taxation of home ownership, however fundamental to the discussion is to recognize the dual perspective thereof.

On one hand, homeownership can be regarded as consumption good. The amount of housing is in that case related to the total income and the allocation function. The decision how to finance housing is based on the total housing consumption and the price of debt and equity. Due to the perceived positive externalities of home ownership and the limited equity available, debt financing should be attractive in order to make households consume a social-optimal amount of housing, i.e. to enable ownership instead of renting.

On the other hand, real estate is considered to be stable or even increasing in value over the time. This makes real estate an interesting investment opportunity. As with other investments, increasing the leverage on the asset means increasing the expected return on investment. Therefore home owners are encouraged to finance their property maximally with debt. A possible home mortgage interest deduction would subsidize investments in real estate and therefore favor these investments over others.

It will be clear that the choice for one of these treatments of home ownership implies a choice for the taxation system of home ownership.

Section 1 describes the current taxation of home ownership in the Netherlands. In section 2 different systems of home mortgage taxation in European countries are considered. Among them, the Swedish, Danish and UK system are given special attention since they are recently changed. Those experiences and examples provide usefull insights for a policy reform in the Netherlands which is described in chapter 4. The Dutch political debate of the last years already shed a light on some proposed new tax systems, which are based on the examples in other countries. Section 3 summarizes and concludes.

2.1   *Taxation of home ownership in the Netherlands*

An elaboration of the taxation of homeownership starts with a more broad description of the taxation of income.

The income tax, applicable to the various kinds of income of a natural person, was initiated in 1914. From that moment on also revenues from housing were taxed. Nowadays, the income tax system distinguishes three sources of income.

The first and most relevant category for this research contains the income from labor and housing. A progressive tax rate is attributed to the sum of all income elements minus the deductable components. The income, unlike certain deduction components, is strictly personal and not transferable. Amongst others, deductibility is allowed for job-related travel expenses, annuity paid for retirement and interest payments on mortgages for first houses. Due to the four-steps progressive tax rate, the first €17,000 is taxed with 2.5%, while all the income over €53,000 is taxed with 52%. Therefore, the effective tax rate, i.e. the average rate attributed to the total income, is higher for households with a higher income. Higher-income households profit therefore relatively more from deduction possibilities.

The second and third category contain respectively the dividend income on equity stakes over 5% and the income on savings and investments. Hence, when property was conceived as an investment good, it would be taxed under the less-preferable system of the third category.

The description of the system of income tax gives us the framework in which the taxation of home ownership should be considered. As described above, property used as first housing accommodation, is perceived as a consumption good, rather than as a durable investment.

The base for the taxation of homeownership changed various times since its introduction in 1914. First, the income from home ownership was determined according to the assessable renting value of the house. Because a progressive tax rate was in action during that time, the effective tax rate on housing increased when income was higher. From the first moment deduction of certain costs related to home ownership was allowed. At that time, ownership ratios were low.

With the new income tax law in 1964, the base for taxation of home ownership changed. The serious administrative tasks associated with the determination of the rental value for the every single property, led to the introduction of the imputed return on housing as tax base. The imputed return, calculated as a percentage of the economic value, replaces the rental value minus the maintenance costs and amortization expenses. The effect of this system change was actually that the new return underestimated the real return. The deduction of costs was restricted to the interest payments on the mortgage.

Further simplifications were made in 1980 and 1997 regarding the value of the house serving as the base for the determination of the renting value. This resulted in 1997 in the WOZ-value, as the base for the return on housing. The WOZ-value, named after the Dutch law on real estate, is determined every two year by the local government and serves as a base for various local taxes.

Although the WOZ-value represents the economic value of the house in case of a obliged sale of the property. The WOZ-value underestimate the market value. The gross return on housing, calculated as 0.6 percent of the WOZ-value, is added to the disposable income, but to a maximum of 9,100 Euros. Again the deductibility of mortgage interest payments remained untouched, wherefore the fictive return on the equity invested in housing is nowadays assumed by far not to cover the wealth benefits of home ownership.

Besides modifications regarding the definition and the calculation of the return, the tax system also faced more fundamental changes with the purpose of smoothing the extreme growth of mortgage borrowing. Where on the one hand the highest tax scales of the current progressive structure slightly declined, also direct changes related to the taxation of home ownership were imposed. In 1997 the deductibility of interest on home mortgages became restricted to the amount that was directly invested in the house, putting an end to the unlimited borrowing for other purposes than investing in housing. Before that limitation, households were used to take additional mortgages on the surplus value of the house for consumption purposes. In 2001 the next round of alterations was introduced. The maximum period of tax-deductibility was shortened to 30 years and mortgages for other than first homes were no longer deductible. On proposition of Hillen, repayment of loans was supported by the introduction of a new tax shelter, the surplus of the imputed return from home ownership over the interest paid on a mortgage loan. The last change in the system is dated 2004, and encourages the home owner to invest the surplus value over the loan of the old house in the new house, in case of a move. The new legislation restricts the deductibility of interest on home mortgage to the amount that the purchase price of the new home exceeds the surplus value of the old home.

Taking into account the previous described special features of the taxation of the home ownership, the debt is almost unlimitedly deductible. Also the equity invested in the house is treated favorably.

Calculations of the CPB show that under the current system of home ownership taxation, the central government yearly subsidizes home owners for around 14 billion Euros.[8] Deducting the money the local government receives from its home owners, the total financial injection to promote home ownership, costs 12 billion Euros. This is the amount of the total tax loss incurred by the Dutch government. Chart 1 shows that the net yearly tax subsidy to homeowners increased from 1995 on. Surprisingly, the tax revenue on imputed rental income, which is dependent on the WOZ-value of the property, did not increase significantly. This is due to the changes of the tax base which neutralized this trend.
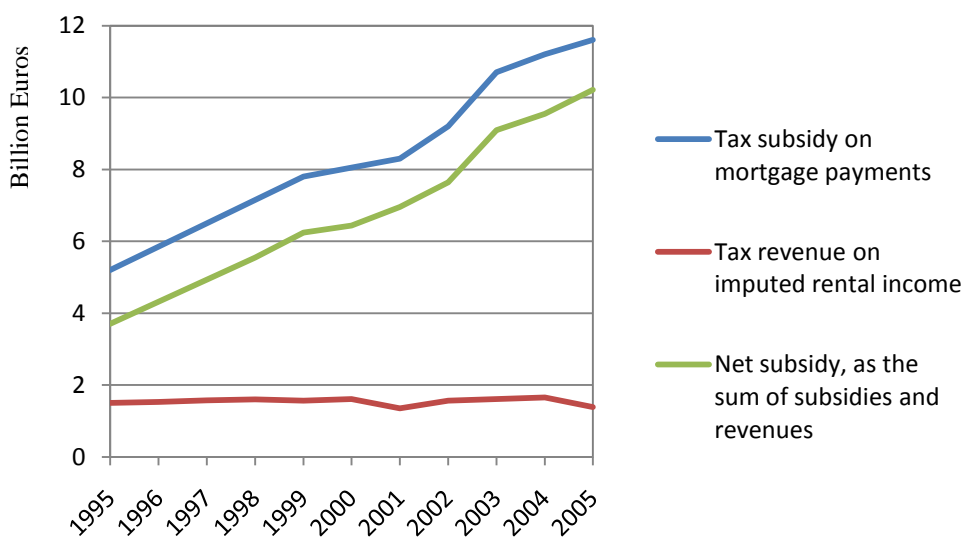
Chart 1: Costs of the current taxation on homeownership to the government 1995-2005, source: CPB, Ewijk et al. (2007)

Under the current system, only home owners profit from the subsidy[9] and the progressive income tax rate makes high-income owners profit more by deducting the interest payments against more favorable rates. Research from the Dutch Central Bank shows that half of the total subsidy of 12 billion Euros, accrues to the 20% highest income households.[10]

2.2   *Taxation of home ownership in other European countries*

Taxation of home ownership has been an interesting policy topic for many governments during the past 20 years. Contrary to Commonwealth countries as Australia and Canada, most of the European governments, like the ones from France, Italy and Sweden, were tax friendly towards

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[8] Koning et al. (2006)

[9] The market for renting property is either highly regulated and subsidized in the Netherlands. Estimations of the CPB calculate a total yearly subsidy of 14 bln euros for households renting a property. Like the subsidization of homeownership, mainly higher income households profit from the subsidies. For further elaboration: Besseling and Romijn (2008).

[10] Van Rooij (2002)

home owners in the past. Driven by the Treaty of Maastricht, European countries were forced to decrease their budget deficit, to comply to the standards of the European Union. The extensive tax subsidies on home ownership became the target of a political reformation process. Tax subsidies were reduced in order to increase the government income. The effects of policy changes on the housing market were widely dispersed and also dependent on the conditions of the overall economy at that time.

While a lot of European countries underwent comparable changes and faced a turmoil on the housing market, the Netherlands are lagging behind, since no fundamental policy changes were made yet. The Netherlands are, in Europe, the only country that has a virtually unlimited possibility of deducting mortgage payments. The Ministry of Finance conducted in 2001 a comparative research on the taxation of home ownership around Europe[11] and concluded that the taxation of home ownership is extraordinary compared to other European countries.

In the next section, home ownership taxation in Sweden, Denmark and the UK is studied in more detail. Also the US is taken into account, since that country is given a lot of attention in the mortgage market due to the crisis on the housing market in the US. The other countries are chosen because they belong to a group of countries that radically changed their system of taxation of home ownership. A brief description of some important past and current aspects of the system is given, together with an elaboration of some other features of the mortgage markets and the impact of the system change on the housing markets. As these countries can be an example for changes in the Netherlands, special attention is given to the relation between the house prices and the taxation. As described before, it should be noticed that interest rates and consumer confidence play an important role in the housing market. Therefore, the economic situation in a country is of paramount importance when considering the effect of a tax reform. Other economic circumstances will lead to a different impact on house prices.

2.2.1   United Kingdom
In the UK, the government used the argument of encouraging home ownership for a long time to legitimate the combination of tax deductibility of mortgage interest and a relative low taxation of imputed rental returns. In 1963, the imputed rental returns were abolished and substituted for a property tax. Therefore, equity invested in housing property, was advantageously treated

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[11] Ministry of Finance (2001) "Fiscale aspecten van het eigenwoningbezit", bijlage bij de Miljoenennota, Den Haag

compared to other types of investments. Highly volatile house prices in the early 1970s led the government decide to remove the amplifying character of the tax system. At that time house prices rose for about 130% in 5 years.[12] Part of the overheated reaction was ascribed to the favored tax system. In 1974, the first tax reforms started, with the limitation of the maximum mortgage amount for which the interest was tax deductible to £25,000. At that time, house prices were on average only £10.000, wherefore only a few borrowers were initially restricted. As house prices rose further, the level was not indexed and the maximum relevant mortgage amount only increased once to £30,000, gradually more borrowers became restricted. The impact was visible in the way that house prices rose less than before: 8% a year over the period 1974 Q4 – 1977 Q4 against 27% yearly over the period 1971 Q3-1974 Q3. The effects did not seem to have permanent influence on the house prices since these rose with 30% in 1979.

The base for taxation of the returns from housing was again changed in 1990. A poll tax[13] replaced the property tax.

Subsequently, in the period from 1992 to 1999, the tax rate on interest deduction was steadily decreased to a zero rate. Preparations of this tax reform had taken several years, therefore the government had not foreseen the regression which started at the end of 1990 and lasted for five years. The new regulation of limited deductibility almost immediately had her impact on real house prices[14], which decreased by almost 50%. Although it might have hurt the economy in its struggle to overcome the recession, 4 years after the initiation of the tax reform, house prices started to rise again.

At the end of the second quarter of 2008, house prices were on average more than seventeen times higher than at the start of the first tax reform in 1974.[15]

2.2.2   Sweden

The most recent serious tax reforms regarding home ownership took place in Sweden. Historically, Sweden had a large spectrum of measures to encourage home ownership and to reduce housing costs. This led to excessive deductions on income but also to a relative high standard of housing of the Swedish population. Together with low rates of homeownership among certain classes of households, a new system with more target specific regulations was

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[12] Nationwide, UK house prices since 1952,
http://www.nationwide.co.uk/hpi/downloads/UK_house_price_since_1952.xls
[13] A poll tax is a tax that levies a set amount per capita. In 1990, the connection between the property value and the amount of tax paid is released.
[14] Corrected for inflation
[15] This regards nominal prices. Accounting for the inflation over the same period, house prices are about 150 percent higher.

required. In order to provide suitable accommodation to low-income households and to encourage home ownership in certain areas, the aims of tenure neutrality and revenue raising were removed and substituted by the generous goals of redistribution and the promotion of equity financing. The period before 1985 the taxation was comparable to the current Dutch system in the way that interest paid on any kind of debt was fully deductible against a maximum marginal tax rate of 80 percent. Furthermore, an imputed rental income was added to the taxable income. The entire tax system was characterized by a wide variety of different tax rates. All kinds of tax shelters and redistributing options were available and widely exploited.

The first round of tax reforms was introduced in 1985, and particularly concentrated on the taxation of housing. Until 1991, the marginal tax rate applicable to the net return on housing was reduced in 2 steps to a fixed rate of 30 percent for every home owner. Also the variety of tax shelters was reduced, leading to an increase of the taxable income. Instead of the imputed rental income, a property tax of 0.5 to 1% of the assessed value of the property was added to the taxable income. The net effect of the new policy was a higher taxation of home ownership, but also a more equal spread of the subsidy over high- and low-income households.

In 1991, the second round of reforms was implemented, this time addressing almost the entire tax system. Fundamental to the income tax reform of 1991 was the introduction of a dual perspective on income, separating earned income from capital income. This opened up the way to a tax system under which capital gains on for instance housing, were heavier taxed than earned income.

A decrease of the tax rate on labor income from 80 percent to a maximum of 51% was expected to decrease tax revenues of the government by a total of 7 percent of GDP. Almost half of the decrease of revenues was expected to be regained by the shrunk of the mortgage interest deduction. The taxation of capital gains at a fixed percentage of 30% was furthermore important for a budget-positive effect of the tax reforms for the government. Before, various kinds of capital gains were not taxed. While interest on loans is fully deductible against the same rate of 30%, the broader tax base increased tax revenues on capital gains.

These measures, together with the abolishment of subsidies on new constructed property and the liberalization of the renting sector, became known as 'the tax reform of the century'.

The impact of the tax reforms became visible immediately. In the midst of a recession, when consumer spending shrank by more than 5 percent over 3 years, the most heavy transformations were made. Chart 2 shows that, even though the policy change only caused a house prices

decrease of 10 percent, the total fall over the period from 1991 to 1995 was measured at 30 percent. The economic recession, overproduction of property and decreasing consumer confidence were responsible for the additional 20 percent price fall. Although households were stimulated to sell off houses and other assets because returns fall, no alternative could be found in renting, because rents increased by 20 percent. Due to an increase of the VAT on building, construction almost ceased completely in 1992.
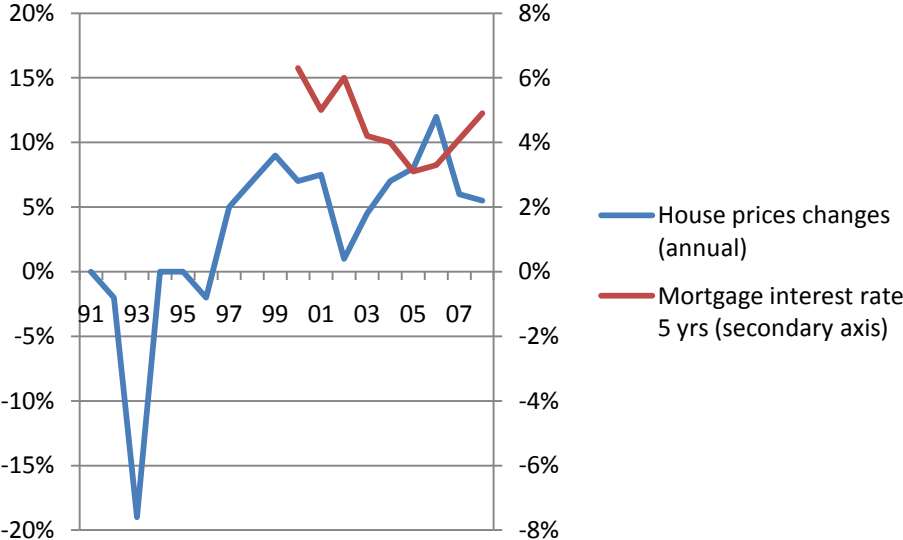
Chart 2: Percentage change of house prices and 5 years mortgage interest rate, period 1991-2007, period after tax reforms, source: Statistics Sweden

Only after 1996, the house price changes again were positive. After again a bust in 2002, house prices rise on average with about 7% a year.

The most recent reforms took place in 2006 and 2007 were the imputed income tax was first reduced and later completely abolished. Despite the extensive tax reforms of the past decades, the prime minister recently announced a review of the current system with the intention to further simplify the taxation of home ownership. A total elimination of mortgage interest deduction belongs to a realistic scenario for the near future.

2.2.3 Denmark

An overview of the Danish tax system is discussed because the Danish housing market shares some important characteristics with the Dutch mortgage market. Also the past tax system in Denmark is comparable to the current system in the Netherlands.

Originally from the 1970s, home ownership was promoted by the full deductibility of mortgage interest payments. Tax rates were between 50 and 73% wherefore the benefits for home owners were large. Nowadays, deductibility is still unlimited, but tax rates drastically lowered. In a series of three tax reforms starting in 1987, the applicable tax rate to earned income gradually lowered to the current percentages of 5 to 15%. This also implied a lower tax rate attributable to imputed rental income. Imputed housing return further decreased in 1994 by lowering the percentage of imputed return to property value from 2.5 to2%. The impact of those reforms was immediately visible in house prices, as shown in chart 3.

From 1999 on, the taxation of imputed rent was gradually transformed into a property tax, which increased the net tax on housing slightly. The Danish system of property taxation now separately addresses the property itself and the land. The property tax differs between 1.6 to 3.4% of the land value, dependent on the location. The property value tax is the tax levied for the value of the real estate accounting at 1% of that value. A tax rate of 3% is applicable to properties with extremely high values. Deductibility still exists for maintenance costs, depreciation and paid property taxes. The Danish tax system does not have a capital gains tax on the increasing value of owner-occupied property.
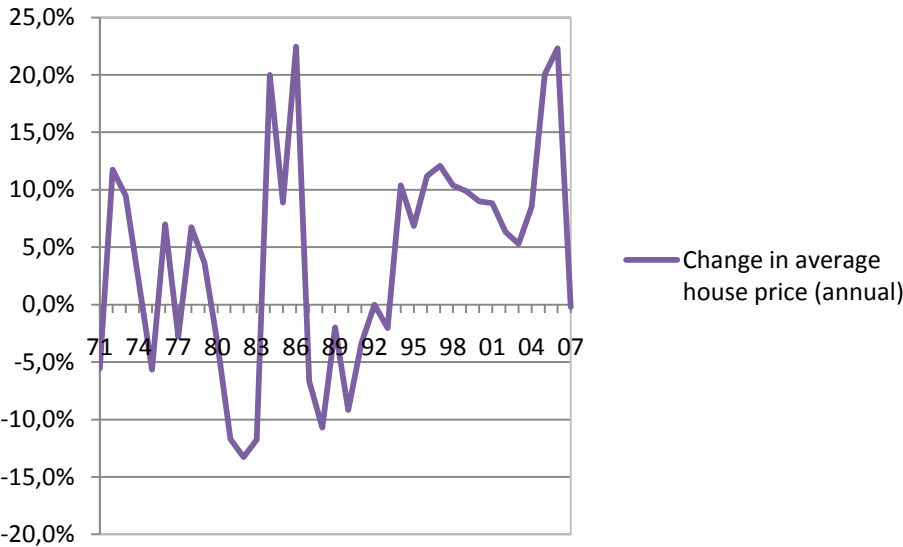
Chart 3: Percent change in Danish real house prices, 1971-2007, source: Statbank, Denmark

As a result of the afore-described measures, house prices where expects to be 15-20% lower for the first 5 years than the level that they would have been without any policy reform. The exact verification of this prediction cannot be made, but chart 3 shows that house prices declined by 30% over the period 1986-1993. After 1994, the economy seemed to have overcome the deflation and again showed double-digit growing house prices. In 2007 the housing market

seems to struggle under rising interest rates and the uncertainty in the US. Accordingly, prices of owner-occupied flats decreased by 10% in 2007. Due to price increases in the sector of single-family houses, the average prices only decreased slightly.

The favorable tax treatment and rising house prices are also visible in the total amount of outstanding mortgages. In 2007, the outstanding lending by mortgage institutes further increased to 268 billion euro, 119% of GDP in 2007. The total mortgage amount was also influenced by the innovativeness of credit lending institutions. From 1996 on, they offered various new mortgage products with features of adjustable mortgage rates, capped mortgage rates and deferred amortization schedules.

2.3 *Conclusion*

Housing policy consists of more than just the favorable tax treatment of mortgage loans. Rental and land occupation policies, subsidization of new construction and calculation and treatment of assessed gains from renting and capital gains from sales; all belong to the wide variety of measures available for policy makers to achieve certain goals on the housing market. The comparison of European countries gives the impression of little agreement about the applicability of each of the measures. Not only the changes within the different systems are a prove of non-conformity, also the ongoing debate and the ever changing objectives of housing policy predict more changes in the near future. As so far, the past and the present of the tax systems related to owner-occupied housing of the Netherlands, Sweden, the UK and Denmark are studied in depth. In general, the Dutch system treats expenditures to owner-occupied housing as a consumption good, and therefore taxes it under income taxation. Accordingly, interest on mortgage loans used to acquire the property is deductible against the applicable income tax rate. An imputed rent is added to the taxable income and a conveyance tax of 6 percent has to be paid by the buyer in case of sale of the house. Compared to other European countries, the subsidization is favorable for high-income home-owners and does not differentiate between new or existing property and the location of the property. Sweden, the UK and Denmark, among other countries, made these considerations subject to tax reforms during the nineties. Driven by the pressure of the EU to restrict the budget deficit and the inability of the current system to achieve its original goals, all countries reduced the mortgage deductibility step-by-step to successively 30, 0 and 15 percent. The impact on house prices seemed to rely heavily on the health of the economy and the length of the implementation period. The direct impact of the system change on house prices in Sweden was only minus 10 percent, but the total house price

decrease ended up at 30 percent, due to the bad economic conditions. Whereas the British economy faced the same conditions, smoothing the tax reforms over 25 years, appeared to decrease the effects on house prices to a minimum. In Denmark, where the government also decided to gradually decrease the tax rate to mortgage deduction, house prices felt in total by 30%. Because the economy was initially in an upswing and the revenues from the policy change were given back to the habitants by a lower tax rate on income, the impact on the total economy was limited.

3. Mortgage markets

Mortgage markets in a lot of countries are facing hard times nowadays. The so-called 'credit crunch' in the US, puts capital markets all over the world under pressure, making the impact of mortgage lending on the financial system visible. The relation between the recent risk increases on mortgage markets and the system of taxation is less clear-cut. The previous chapter elaborated on the incentives of the Dutch tax system. The fiscal rules influence the amount of mortgage borrowed and the debt/equity ratio. It goes too far to point the tax system as one of the causes of the credit crunch, but the consequences are dependent on the current conditions of the mortgage market.

This chapter aims to touch upon the circumstances under which a possible change of the tax system must be considered. The circumstances are important in order to accurately predict the impact of a change on the main variables like the house price. Paragraph 3.1 elaborates on the current circumstances of the mortgage market in the Netherlands, while paragraph 3.2 is dedicated to the credit crunch on the US mortgage market. In the US, the impact of a sudden decrease of house prices on the total economy became visible. Together with the analysis of the Dutch market, it may be possible to precautiously predict the future influence in the Netherlands.

3.1 Mortgage market in the Netherlands

Research of NYFER indicates the house price and the interest rate as the most important risks factors related to the current situation of the mortgage and housing markets. An increasing interest rate will cause increasing expenditures to housing whereas a decrease in house prices increases the probability of the loan value being more than the house price. Both, an increasing interest rate and decreasing house prices are expected as a result of tax changes.

The correlation between the interest rate and the house price is visualized in chart 4, which shows the development of the average mortgage interest rate and the average house price over the period from 1995 to 2007. House prices seem to negatively correlate with mortgage rates, although the one-to-one trend seems to be broken during the last two years. Research of Catte et al. (2004) suggests a negative correlation between mortgage rates and house prices, although the relation might be distorted by the relative slow adapting house prices, inflation, GDP growth and a high level of consumer confidence.

Chart 4: Average house prices and average mortgage rates 1995-2007, source: Kadaster

In order to indicate the impact of a change, chart 5 displays the development of the mortgage lending. The blue bars show total outstanding mortgage debt. Over the period 1997-2007, the total amount of outstanding debt increased by more than 200%, to a total amount of 587 billion Euros. The major part of this debt increase was caused by the increase of house prices, in combination with the favourable tax treatment of mortgage payments. Because borrowing was relatively cheap[16], the surplus of house price over the total outstanding mortgage, was used to further increase the mortgage loan. The debt was frequently spent on consumption purposes rather than invested in the quality of housing. Comparing those figures to other European countries shows that Italy, a country without any mortgage subsidisation, only has a mortgage debt-to-GDP ratio of 16% in 2006. In Denmark, a country with mortgage subsidization, this was 98%. The figure further shows the vulnerability of the economy to the mortgage lending sector. A high mortgage amount will on average enlarge the impact of interest changes. The speed in which the economy reacts on interest changes is, about others, dependent on the fixed rate period.

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[16] The CPB calculates net interest costs, including commissions, in 2002 at 2,7% of the borrowed amount.
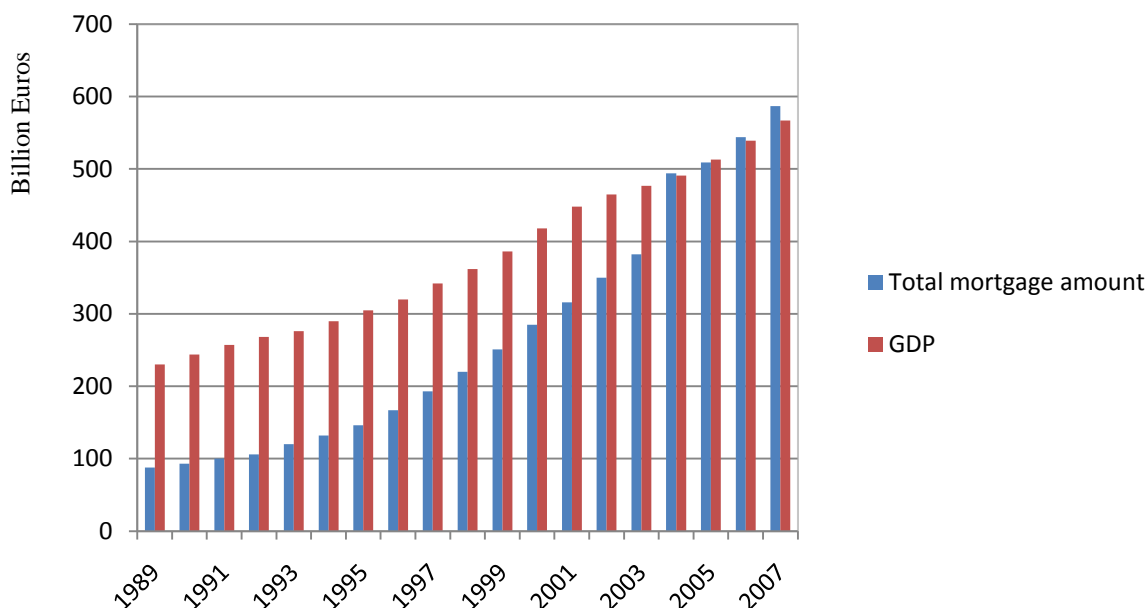
Chart 5: Total outstanding mortgage amount for housing, GDP, 1989-2007, source: CBS

Even more important is the value of the property that covers the mortgage loan. This is measured by the loan-to-value-ratio (LTV), which relates the indexed purchase price of the property to the mortgage amount. The average LTV-ratio was 30% in 1988. Due to increasing interest rates, mortgage banks and household became more cautious in lending and borrowing, whereby households financed more with equity and the LTV-ratio decreased to 25.8% in 1992. From that moment on, due to increasing house prices and low interest rates households where forced to borrow higher mortgage amounts. This resulted in an average LTV-ratio of 40% in 2008.[17] Mortgage banks did not discourage this behaviour because their interest earnings increased and the risks seemed moderate because house prices were constantly increasing. In the period 2001-2007 mortgage lenders introduced the so-called 'top-hypotheek', enabling home owners to borrow to a maximum of 125% of the value of the property. About 60% of the newly initiated mortgages had a LTV-ratio of 125%.[18] The average LTV-ratio of mortgages negotiated in this period is 113%. Households with high LTV-ratios are vulnerable to changes in house prices. In case of a sale of the property, a residual loan will last. With these LTV-ratios, The Netherlands are again one of the most extreme in Europe; average LTV-ratios on newly mortgages are highest is Ireland (95%) and lowest in Hungary (40%).

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[17] 'Speech director Brouwer 'The Dutch housing market: stable or stagnant?', H.J. Brouwer, director of the Nederlandsche Bank, DBV symposium, Zeist, 19 May 2008
[18] Haffner (2003)

Switching now to a more micro economic viewpoint, the ratio of total income to mortgage payments measures the vulnerability of households to a sudden increase of interest rates or a decrease of income. Research of the CPB shows that nowadays, one out of six home owners spends half of their disposable income on mortgage payments. On average, housing expenditures, including gas and electricity expenses, account for 25% of total expenditures. Chart 6 displays the trend of gross income and gross mortgage expenditures over the period 1993-2004. Over the period from 2004 until now, no data is available. The figure shows that a larger part of gross income is spent on mortgage payments. In 1993, 8.6% of income was spent on mortgages, while in 2004 this was already 11.7%. A study of research institute Nyfer[19] predicts income-to-interest ratios increase to 27% on average in 2009.
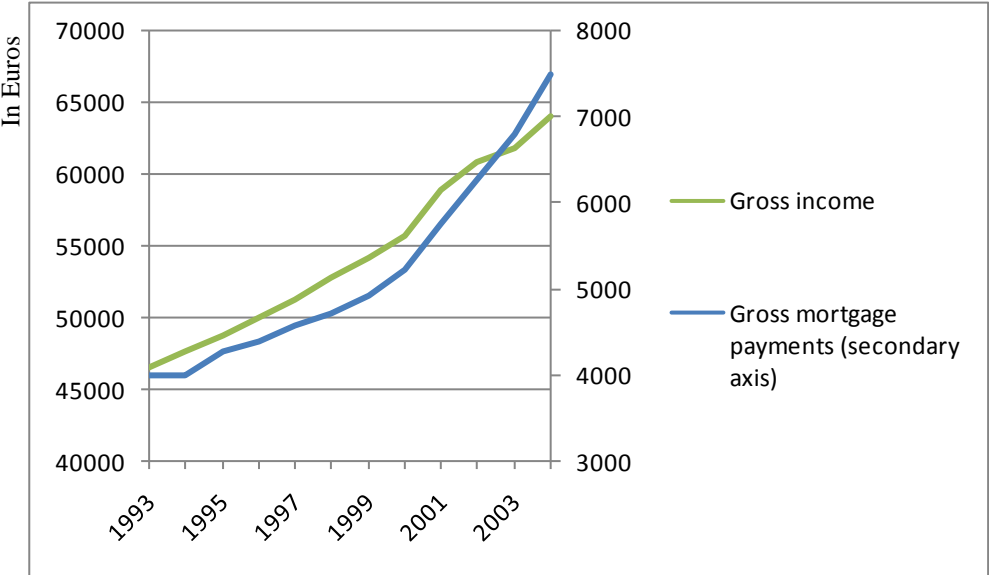
Chart 6: Gross income and gross mortgage expenditures over the period 1993-2004, source: CBS

Interest changes influence the gross mortgage payments, but only after the expiration of the fixed interest period. The Dutch Central Bank concludes in her latest research that the amount of mortgages with a fixed interest period of less than 1 year decreased from 44% in 2005 to 19% in the first quarter of 2008. Currently, most mortgage loans, about 45%, have a fixed interest period of 5 to 10 years.

Aside of household vulnerability, banks have significant uncertainty and risk incorporated in their mortgage portfolio. The supply side of the mortgage market experienced a trend of increasing proficiency of banks, intermediaries and other mortgage lenders. Due to increasing

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[19] Nyfer (2005)

competition, lenders are forced to offer low interest rates and competitive fixed rate periods. As shown in chart 7, interest rate spreads are decreasing. The figure shows the trend of the average mortgage interest rate offered to households. The chart also displays the rate at which banks are able to borrow the money at the ECB. The credit spread decreased over the period from 11 basis points in 2003 to 6 basis points in 2007. Furthermore, the term structure of interest rates shows that interest rates were expected to increase over the period. In 2007, the mortgage interest rates for the various fixed rate periods do not differ a lot, implying an uncertainty over the future interest rates.
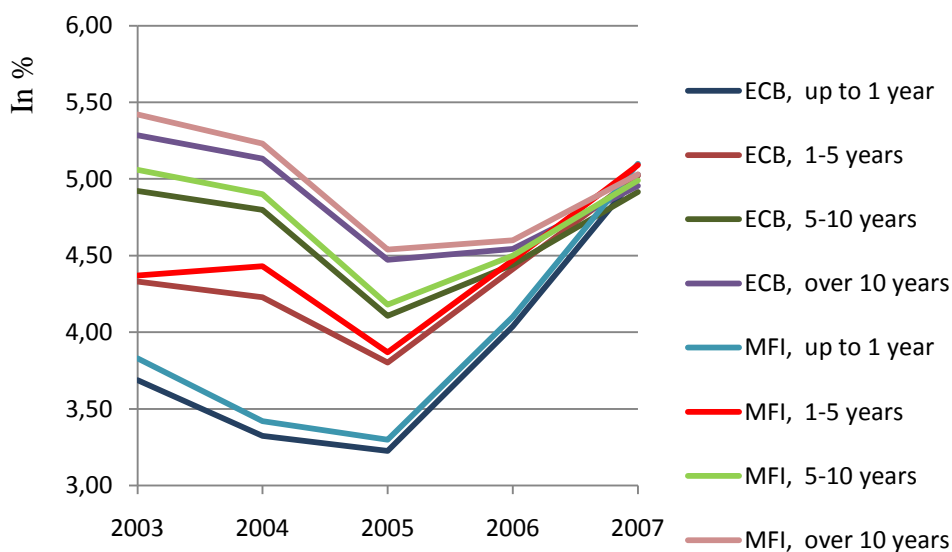
Chart 7: Trend of different ECB lending rates to MFI for house purchases, trend of mortgage rate to households, period 2003-2007, source: DNB, ECB

Furthermore, in the period between 2003 and 2005, borrowers were able to borrow against interesting conditions. In the expansion drift of mortgage banks, they are becoming less selective about lending restrictions and constraints regarding maximum loan amounts and income levels, resulting in high LTV- and interest-to-income ratios, as described before. Such high ratios imply that a mortgage loan, in case of default, will not be completely recovered by selling the property. The total balance of all Dutch banks, consist for almost 35 percent of mortgage loans. Together with the credits and consumer loans, almost 60 % of the total balance is lent to households.

3.2   The mortgage market in the US

A single section of this paper is dedicated to the situation on the mortgage market in the US. The reason for this is two-folded. First, the large depreciations on mortgage portfolios and failures of various mortgage lending institutions caused a lot of rumour and uncertainty in financial markets. This uncertainty is also visible on European markets because financial markets are

heavily intertwined and Dutch banks are exposed to the risk of American mortgage loans by for instance mortgage-backed securities. Second, the events in the US are an example of the vulnerability of the financial system to interest changes, in combination with risky mortgage loans. As described before, also in the Netherlands, the riskiness of mortgage loans increased the last years.

The mortgage market in the US consists of two separate, but interacting segments. The prime-lending segment serves the home-owners with a solid credit history and good financial forecasts. Borrowers, to whom access to the prime market is denied, can attract a mortgage loan from mortgage banks and other loan suppliers on the subprime market. This market is not new, but has developed fast during the previous years as a consequence of tighter redlining practices[20] in certain geographic areas, where prime loans are denied to a large group of households. In the subprime market, unlike in the prime market, mortgage banks use a differentiating approach to pricing in order to offer a loan to as much people as possible. The variability and height of the interest rate is determined in accordance with the risk related to the specific circumstances of the loan and the borrower. Besides interest rates, upfront fees for application and appraisal are significantly higher and make that on average, mortgage payments are over 2 percent point higher for subprime loans.[21] Overall, banks make themselves the reservation to mitigate the lending conditions in case of a significant change of the borrowers' risk profile. The acceptability of the borrower is only determined according to the possibility to pay back the loan from the home's value, wherefore mortgage banks heavily rely on the value of the collateral to cover the risk of default.

The growth of the subprime market expressed itself in the late 1990's. From 1997 to 2003, the total amount of outstanding subprime mortgage loans grew by more than 160 percent to 332 billion, 10 percent of the total mortgage market. The market of subprime lending is dominated by specialised mortgage banks, that do not provide additional depository services. Because also the level of securitization[22] grew to around 60 percent, the risk spread through the entire financial system. Research suggests that, as a result of the different borrower population, the amount of default on subprime loans is six times higher compared to normal prime loans.

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[20] The term 'redlining' refers to the practices of banks, insurance companies and other service providing institutions of denying access to services to residents of certain areas, usually based on race.
[21] Chomsisengphet and Pennington-Cross (2006)
[22] The term 'securitization' refers to the process of lending institutions to pool and repack financial assets, for instance mortgages, with the goal of selling these packages to investors.

The recent crisis is caused by a combination of circumstances. Low interest rates, even as low as 1 percent in 2003, tempted a lot of borrowers to refinance their fixed mortgage loan of about 10 percent, by a variable rate mortgage loan and additionally increase the mortgage amount. The additional funds were frequently used for consumption purposes. As long as the variable interest rate is low, there do not appear any problems. But from 2006 on, the variable interest rate started to rise. At the same time, house prices started to decline. From June 2006 to April 2009, house prices declines on average by about 36%. From mid-2005, the number of delinquencies grew and especially concentrated in the category of risky adjustable rate subprime mortgage loans (ARMs). More than 20% of the 3.6 million loans in this category, meaning 720,000 households, faced foreclosure problems at the end of 2007. Also other segments faced payment problems, resulting in a total of 1,5 million mortgage foreclosures.

Bernanke[23], president of the Federal Reserve, the Central Bank of America, expects the number of delinquencies to rise even more due to rising interest rates on ARMs. Furthermore, house prices will decline in order to find back the balance of supply and demand in the market.

The consequences of the credit crunch are widely known. Besides individual problems, the payment problems have wider influence on other homeowners in the neighbourhood of the defaulter, who see their property to decrease in value. For this research it would be too far off the subject to examine all the consequences for different stakeholders. Banks, in this research the most important stakeholder, have been forced to write off large amounts of their mortgage portfolios.

The credit crunch has by now influenced the general drift of the financial markets all over the world. More specific, also Dutch banks have been forced to write off large amounts of their portfolios which US subprime mortgages.

3.3   Conclusion

The Dutch mortgage market has shown impressive, double-digit growth rates during the last years. Besides the total outstanding amount of loans, which is continuously growing, also the average loan amount of households grew. In 2007, the total mortgage amount of Dutch households amounted 116% of the GDP. Furthermore, the loan-to-value ratio and the income-to-

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23 Bernanke, B.S., 2008, "Housing, Mortgage Markets, and Foreclosures", At the Federal Reserve System Conference on Housing and Mortgage Markets, Washington, D.C., December 4, 2008

interest ratio increased during the past years, implying a growing exposure of households to increases in interest rates and decreases of house prices.

The credit crunch in the US has shown the impact of an interest rate increase, in a situation where mortgage rates are adjustable and LTV-ratios are high. Banks have been forced to write off large amounts of their mortgage portfolios and a lot of home owners were forced to sell their house.

The recent events in the US show how fragile the economy might be to house price changes and to changes in the interest rate. In the US, house prices fall for 3 years in a row for in total 36%.

4. Towards a new system of taxation

Since it is getting clearer that the initial goals of the tax incentives to promote owner-occupied housing are not fulfilled, the aim to a tax reform is becoming more visible. The weakest potential home-owners, the first time buyers, face higher house prices and are not able to buy a house. Furthermore, the desired high ratio of home-ownership, as one of the purposes of the system, is not reached. Comparing the year after year stable home ownership rate of 53% in the Netherlands to 75% in both Ireland and Norway, countries with a far less favorable tax treatment, it seems that tax subsidization is not the best way to encourage home ownership.[24]

Despite the price increases in the housing market and the recent debacles of subprime lending in the US, not all are convinced of the necessity of a system reform and the countering effects on house prices. Some argue that it are actually the younger, middle-income households that are most affected because housing demand in the low segment increases and price decreasing pressure will not work there. Wealthy homeowners are less hard hit because they have the possibility to change their financing structure and rely more on own equity sources.[25] Also the expected additional tax revenue for the government, is said to be overestimated. Behavioral changes and reallocations as reaction on the tax reforms are not accounted for.

Despite the countervailing powers, various changes are proposed and some of them already introduced. With respect to a reduction of the subsidy on home-ownership, lot of attention was given to the researches of Briene (2005) and the CPB which describe the impact of a certain new system on house prices, leverage and cost ratios. The wide-ranging approach of these studies, makes them suitable for a broad analysis of the Dutch macro-economic environment. While more studies elaborate o\n the relation between house prices and interest rates and between house prices and the tax system, the researches of Briene en CPB are distinguishing in the sense that they provide absolute expected changes of fundamental economic variables related to the introduction of a new tax system in the Netherlands. Experiences in other countries also provide useful experiences for the impact of a tax reform on the economy. Although those examples of the abolishment of tax favorability of mortgages do not have to be representative for the situation in the Netherlands, they can learn us important lessons about the accurate preparation and planning of changes, so can they be an example for the exact design of the new system.

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[24] Atterhög, (2005)
[25] Follain and Sturman Melamed, (1998)

This section elaborates on the different designs of a new system of taxation of home ownership. The first paragraph describes different scenarios and ends with a choice for one of them. Paragraph 2 treats the research about tax reforms and their influence on important economic variables. This researches are compared to the measured impact of tax reforms in other countries. Eventually, this results in an estimation of the impact of the most plausible tax restructuring, which will be used later in this paper to assess the value changes in the mortgage portfolio.

4.1 The possible designs of a new tax system on home ownership

The debate about a change of the taxation of home ownership started about ten years ago. Since then, various proposals have been made to structure the tax change. In 2007, the CPB united all information into one study on the impact of the different designs. This research distinguishes four different measures to come to an elimination or reduction of the subsidization of home ownership, which will be most likely the base for a possible tax change. In brief, the four measures are

1. The taxation of home taxation as an ordinary investment asset;
2. The elimination of all tax shelters and additional income related to home ownership;
3. The restriction of the maximum mortgage loan over which interest in deductible or
4. The decrease of the maximum marginal tax rate for deduction.

All four are discussed in detail starting with the most impacting one (1.) and ending with the less impacting one (4.). Although shock effects can not be ignored because the market is build on trust and confidence, it is expected to matter whether the change to a new system is smoothed out over a longer period or introduced at once.

The first measure touches upon the current treatment of the return from housing as a consumption asset. By changing this approach to an investment-oriented taxation, returns from housing are treated equal to returns from savings and investment in financial products. According to the previous described categorical system, housing would then be taxed in the third category. This implies the calculation of a fictive return over the net wealth of the household. The net wealth is calculated by the value of the property minus the mortgage loan on the property. The determination of the value of the property is based on the WOZ-value. An imputed return of 4% is assumed over the net wealth. This return is taxed against a fixed rate of 30%. The taxation of home ownership according to this system is actually more than an elimination of tax deductibility. It also means a taxation of the equity invested in the house.

This first design of a new tax system is not perceived as a very realistic option, as it does not encourage equity investments in housing. This option can be rather helpful in determining the maximum impact and can be a tool to compare the impact of other possibilities.

The second possibility is to eliminate all taxation measures from home ownership, which is perceived as a plausible way of reforming. With the abolition of the tax deductibility of interest payments, also the imputed return on housing, the conveyance tax and the local taxes to owner-occupied housing disappear. In this way, the equity invested in housing is free of taxation. One of the drawbacks of this system is that it stimulates debt arbitrage, since loans used to finance other assets are deductible from the total asset value. As a result, mortgages will become less attractive and homeowners will try to finance their houses with own sources or with consumer loans and credits. In order to circumvent the problem of tax avoidance, the system should be designed in a way that a certain financing structure is assumed and that an assumed amount of equity is free of taxation. The difference between the market value of the house and the imputed equity amount is added to the total asset value, while the mortgage amount is deducted from the total asset value.

The last two designs of a possible tax reform actually inhere a curtailment of the tax-deductibility of mortgage interest. In other countries like Denmark and the UK, it is shown that this can eventually lead to a complete abolishment of the tax subsidy of home ownership. First, the marginal tax rate against which interest is deductible can be lowered or maximized. This system is proposed by the Dutch Labor Party. At the moment, the marginal rate is fully dependent on the total income of the tax payer. By lowering the maximum marginal tax rate to for instance 42 percent, especially high-income homeowners will face a decrease of the profit from tax deduction. Effects on house prices will therefore differ among market segments. High-income mortgagees will usually have higher priced houses. As a result, houses in the more expensive segment will decrease in price because housing costs for these people will increase. On the other hand, demand on the market for houses with a moderate price will increase. In the end this may lead to unexpected house price increases in the lower segments.[26] Maximization of the marginal tax rate can also be achieved by taxation under a fixed rate, making the proceeds of deductibility no longer dependent of the income. This will not overcome the possible price increases in lower segments.

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[26] Ewijk et al. (2006)

The same effects are expected for the fourth design of the change of home ownership subsidization, if the size of the loan over which interest is tax-deductible is restricted. In England, the government used this measure to restrict the tax subsidization. Home-owners are discouraged to borrow more than the maximum amount of for instance €250,000 or €500,000, because over the additional mortgage amount no tax deduction is possible. The effect of this reform will be small initially, but will gradually increase as house prices increase. As a variation on this system, the maximum relevant loan can be gradually diminished over 30 years, in order to give households the ability to adapt to the new system and change their amortization scheme accordingly. Effects are smoothened out over a longer period and in the end home ownership is not longer subsidies by means of favorable taxation. The amount of the loan that exceeds the maximum amount will be more expensive. Therefore, borrowers are expected to reduce their outstanding mortgage loans. If they do not have equity to replace the withdrawn debt, they will be forced to lower the market value of their house by buying a less expensive house.

Additional to the changes related to the tax-deductibility of interest payments, other regulations concerning homeownership can be eliminated too. Although this can change the impact significantly, none of these additional measures are accounted for.

The CPB revises the different new tax systems on their impact on the after-tax interest rate and on house prices. According to the CPB, option 2 is perceived as the most likely design of future tax reforms. Therefore, this is used as a base for further investigation. It can be reasoned that the other designs which only restrict the tax-deduction, have less far-reaching results and thus has less impact on the after-tax interest rate and on house prices. On the other hand, the first proposed restructuring system, will have a more dramatic influence on house prices since it taxes homeownership instead of subsidizing it.

The government will probably (partly) compensate the loss in consumer wealth, for instance by cutting the tax rate on income significantly. This will increase the disposable income and will relax the effects of the tax reform. Because the form of the redistribution is not known and will not be equally divided over all tax payers, it is not taken into account in calculating the impact of the tax reforms. Furthermore, in order to effectively smooth the ongoing rise of house prices, a certain permanent effect on disposable income is necessary.

4.2 The impact of a new system

The evaluation of the impact a new system of taxation on various variables is the first step in the evaluation of the impact on the value of a mortgage for a bank.

First, existing homeowners, with a mortgage loan, are confronted with an increase in housing costs because the interest payments are no longer tax deductible. The flow on the housing market is stuck temporarily because home owners, with a normal growth in disposable income, have to spend more on the same mortgage. A certain percentage of the home owners will eventually be forced to sell off their house and prepay their mortgage in order to decrease their unaffordable housing costs.

Second, because the after-tax interest costs for a certain mortgage amount increase, mortgagees are, all other things being equal, stimulated to lower their mortgage amount. If mortgagees are only able to pay equal interest costs on lower mortgage amount, mortgagees are stimulated to decrease the mortgage amount borrowed. Assuming an equal amount of equity invested, mortgagees will no longer be able to pay the same house prices. This causes changes on the demand side of the housing market, in line with the static supply corresponding to the short term of our analysis, in the end price decreases.

Before being able to determine the impact on house prices and housing costs, the policy change in tax system should be transferred into a measurable change. The tax change is modeled by an increase of the after-tax interest rate. Together with the change in taxability of certain income and cost components, these changes cause changes of other variables.

The goal of this research is to determine the impact of the change of the tax system on the value of a mortgage portfolio of a bank. In the determination of the value of a mortgage to a bank, several variables, for instance the house price and the interest rate, are used. If those variables change, the value will change.

For the estimation of the impact of a tax reform on important variables in the economy, various researches can be used. Also usual researches that study the relation between house prices and interest rates and house prices and disposable income can be suitable. In subsection 1, the impact of the tax reform on house prices is described. Subsection 2 describes the impact of the tax reform on housing costs, while the third subsection elaborates on the impact on other variables.

4.2.1 Change of house prices

The research of the CPB, that uses the standard model of Poterba (1984), analyses the value any consumer attributes to housing. A structural model is built in which house prices play an important role to link supply and demand of housing. Both are independently estimated based on several input variables. This dynamic approach towards the housing market enables us to introduce more variables than just the interest rate and disposable income to determine the supply and demand. Because the model assumes equality between supply and demand, this does not seem to be the best approach for this study. As an effect of the tax reforms, exogenous shocks are expected wherefore house prices will only adapt with a time delay.

We rely on the research method used by Briene et al. (2005) that models the tax reforms as an exogenous increase of the interest rate. Based on an equation relation, house prices are estimated from the development of important variables as disposable income and interest rates. Besides the change in average real purchase price, the research also elaborates on the impact of the tax reforms on the renting market, and the transaction volume of newly build en existing property. Although interesting, we do not further consider that part of the research.

The model of Briene has the advantage of a two-folded perspective. On one hand, it measures the impact on macro-economic variables, like the house price and the transaction volume and takes into account the whole economy as spectrum of study. On the other hand, it also gives inside in micro-economic consequences of the tax reform in the way that it splits out the impact to difference types of households with different housing positions. The research design implicitly assumes that the relation between house prices and interest rate that appeared in the past, remains the same for the future, which can be seen as a disadvantage of the model.

The model splits the housing market in owner-occupied and renting property. Both markets do function with government intervention, wherefore price setting is not optimal. On the market for renting, which we will not consider further, rent increases are limited and low-income households are subsidized. On the owner-occupied market, the government intervenes by means different forms of taxation and her environmental planning policies.

Housing is perceived as a primary consumption good. A certain minimum amount of income will be spend on housing anyway, while additional housing expenses are influenced by income. Renting and owner-occupied housing are furthermore perceived as substitutes, although the relation is not perfect, due to switching costs and non-monetary reasons

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In the model, the average real purchase price is estimated from different explanatory variables. Although theory predicts that demographic factors and the supply of newly build property play a very important role in explaining developments on the housing market, the effects only occur on the long run. We therefore ignore changes in household size, population structure and newly build supply of property. It is expected that on the short term (to 5 years) especially mortgage costs, consumer confidence and income play an important role, while on the long term demand is determined by household size and age.

Briene (2005) tested various variables. The research used the development of the variables over the period 1976-2000 as estimation period and derived the following explanatory equation of significant variables for the change in the average purchase price:

$$\Delta_{\%}\left(average\ real\ purchase\ price\right)_t = \alpha_1 * \Delta_{\%}\left(average\ real\ purchase\ price\right)_{t-1} + \alpha_2 * \Delta_{\%}\left(disposable\ household\ income\right)_t + \alpha_3 * \Delta\left(aftertax mortgage\ interest\ rate\right) + \alpha_4 * long\ term\ equilibrium + \varepsilon \quad (1)$$

The equation shows that the change (Δ%) in average real purchase price is explained by the percentage change of the house price in the previous period, the percentage change in disposable income, the change of the mortgage interest rate and the long term equilibrium. The association between average real purchase price and quality injections in housing was tested as well, though no significant relation was found. The housing market is driven by sentiments and speculations, wherefore a recent change in average real purchase price (with a time lag of 1 period) still influences the change in house price at time t. The mortgage interest rate influences the average real house price negatively, implying that a low mortgage rate enables households to buy more expensive houses and therefore puts a positive pressure on house prices. Furthermore, the long term equilibrium is found significant. This formula shows that an economy in good condition, with increasing house prices and a positive development of income, will better be able to absorb the consequences of an interest rate increase. Once more, timing of the measures seems to be very important.

Based on formula (1) Briene found the following coefficients with accompanying t-statistics:

Variable	Coefficient	T-statistic
Average real purchase price t-1($\alpha 1$)	0.414069	4.419532
Disposable household income ($\alpha 2$)	2.381283	5.621096
Mortgage interest rate ($\alpha 3$)	-5.314888	-4.489904
Long term equilibrium ($\alpha 4$)	-0.133321	-6.396989

Table 1: Coefficients and t-statistics from regression of equation 1

Table 1 shows the coefficients for equation 1. The signs of the coefficients corresponds with the theoretically expected relation between the variables. Disposable income influences the testing variable positively. The results show that a change in the mortgage interest rate of 1% means a decline in house prices of 5.3% in. The negative coefficient for the long term equilibrium implies that the other variables are more short term-oriented and overestimate the change of house prices.

Further, a certain situation of the explaining variables is assumed in order to calculate the effect on house prices.[27] Under these circumstances, based on an average interest rate of 5.5% and an average tax rate on income from labor, the effect of an increase of the net interest rate as expected from the change of the tax system means a decrease in house prices of 9% in the first year and 14.7% after 10 years. These percentages are important, because these will be used as the exogenous shock in the valuation model.

In the primary model, the entire housing market is considered at once. Changes are expected to be different among market segments, due to different incomes, leverage and mortgage contract rate. Also type and price of property characterize certain demanders. It is assumed that price setting in each segment happens independently of the price setting in other segments. Crosswise price elasticity of segments exists limitedly, because households adapt only slowly to price changes as a result of conveyance tax.

4.2.2 The change of the housing costs

As a result of the new system of taxation of home ownership, households will face a change in housing costs. Again, the calculations of the research of Briene (2005) are used to determine these changes in disposable income for various types of households. The effect of the total system change is calculated, rather than the impact of every single reduction or elimination. First, as a result of elimination of mortgage interest deductibility, net mortgage costs will be higher. Second, the elimination of the imputed rental income and the local property taxes will reduce the housing costs and increase disposable income. Third, the elimination of the conveyance tax lowers the costs of moving. While the other changes are relatively simple to predict, the impact of the elimination of conveyance tax is less straight forward. A cost reduction of 6% of the purchase price is saved at the moment of purchase. The effect on yearly housing

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[27] The research accounts for a mortgage interest rate of 5%, an average house price of €220,000 and an average contract period of 30 years.

costs is calculated as a percentage of the value of the house. By dividing the total savings from conveyance tax by the average period between purchase and the following sale, the yearly cost reduction is calculated. With an average period of 15 years, the yearly reduction is 0.4% of the value of the house. Newly constructed houses are relieved from conveyance tax, wherefore the impact is less. Assuming that one fifth of the housing transfers regard new construction, the impact is reduced to 0.32%. The impact is further reduced by the fact that expensive houses change less frequent from owner than cheaper houses. This brings the final impact from the elimination of the conveyance tax to 0.258% of the value of the house.

Overall, the research concludes that the implementation of the tax reforms on home ownership will lead to a decrease in disposable income of 7 to 12.5%, dependent on the income situation of the household (i.e. income vs. allowance and size of income). Although the real decrease in disposable income is highest for the higher incomes, the percentage decrease is not. Higher income households do on average finance with a lower leverage and attributed a lower percentage of their disposable income to housing. Therefore the percentage decrease in disposable income is highest for the 20 to 50% lowest incomes. Furthermore, the change of housing costs will be highly dependent on the housing situation. Also the type of mortgage contract and the housing value are important determining variables. Young households who intent to buy their first house will profit most from the tax reforms. Besides the decrease in house prices resulting in lower purchase costs, those households will feel the impact of the elimination of conveyance tax immediately.

4.2.3 The change of other variables

Besides house prices and interest rate, also other variables are expected to change as a result of tax reforms. Those variables are only briefly touched upon in this subsection, because they are not relevant for an investigation of the value of a mortgage, the final goal of this paper.

First, dependent on the way of redistribution of the additional tax proceeds, less wealthy households can observe an increase in their disposable income. If this happens, the pressure on the lowest segments of the market will also be increased because housing becomes better affordable for previous renters.

Furthermore, side effects can be expected. Reallocation between renters and owners will cause differing consumption patterns. Temporarily, sales at the market for existing property will slow down because borrowers may face negative equity values and will delay sales to wait for a new

increase in house prices. On the other hand, the curtailment of conveyance tax, which is also part of the tax reform, will decrease costs of moving and might give transaction volumes a positive incentive.

Third, the construction volume will decline as a result of the tax reform. Because both transaction volumes and house prices decrease, constructors will face difficulties to sell the property for a good price. Besides that, constructors face higher interest rates on loans necessary for making the investment in the land and buildings. The uncertainty on the demand side will discourage constructors to build new houses. The decrease in construction is also shown in Denmark, where, as a result of tax reforms, construction rates decline to almost zero in 1992.

4.3. Conclusion

This chapter elaborates on a new tax system. Based on the research of the CPB, four main new ways of taxation can be distinguished. Among them, the one in which all taxation on home ownership is removed, is perceived as most likely. In that system, on one hand, imputed rental value, conveyance tax and local property taxes are removed. On the other hand, the deductibility of mortgage payments is removed either. In this system, debt and equity invested in housing are equally taxed, wherefore, in contrast to the current system, debt financing is no longer encouraged over equity financing. By the introduction of this system, the government in total saves 7 billion of tax subsidies.

As a result of the tax reforms, Briene (2005) expects that both house prices and housing costs will change. Also construction volume may change, but this variable is less important for the remaining part of the research.

The change in house value is estimated by using a regression analysis. Significant variables are the change of house prices in the previous period, the interest rate, the disposable income and a variable indicating the long term equilibrium. The coefficients are estimated using data over the period 1976-2000. Dependent on the assumed estimation period, the expected decrease in house prices varies from -9% in the first year to -14.7% after 10 years. As a result of different income and mortgage situations of households, the decrease in house prices is expected to vary among types of property and value of the property. Since high-income households are expected to face a smaller percentage increase of housing costs, the price pressure on the high income segments is lower. Especially first time-buyers will profit from the elimination of conveyance tax and the decrease in house prices.

The negative effects of house price decrease are strengthened by the increase of housing costs. Again, the increase in housing costs is dependent on the income situation. The expected decrease in disposable income is between 7 and 12.5%. Households with a high marginal tax rate will, on one hand face a higher disposable income as a result of elimination of tax deductibility. On the other hand disposable income will decrease by the elimination of imputed rental income. Because housing costs attribute for a smaller percentage to disposable income, high-income households will face a lower percentage decrease. The largest effects are expected to occur in the 20 to 50% lowest income households.

The calculated changes of house prices and housing costs are used to calculate the changes in the value of a mortgage.

5. Mortgage valuation

Mortgages are perceived as one of the most difficult assets to value due to their features of prepayment and default and their restrictions thereon. The value of a mortgage for the lender depends on the payments he expects to receive from the contract in the future. A regular way of valuing mortgages is by means of option valuation. Dependent on the characteristics of the mortgage, a particular formula is applied to obtain the value. The terms and conditions vary widely between different mortgage contracts and show patterns regarding countries and types of households. Therefore, it is important to set up a valuation model that touches upon the different characteristics. This section elaborates on the valuation technique applied in this research. Before portraying the model, section 1 gives an overview of the mortgage literature. Special attention is paid to the research on Dutch mortgages. Together with the information supplied in chapter 3, this leads to the valuation model, explained in paragraph 2.

5.1. *Modelling Dutch mortgage contracts*

The contract terms of Dutch fixed rate mortgages rival on complexity all other financial products concerning valuation issues. The features of default and prepayment and the connection between those complicate the valuation. Especially the restrictions on costless prepayment, characterize Dutch mortgages. Various researches are conducted on modelling the possibilities to default and prepay. Some consider the two as separate liquidation reasons, while others also model the interaction between both. Moreover, authors distinguish between rational and suboptimal prepayment, accounting for non-financial reasons of prepayment such as demographic factors that influence movement ratios and thus non-financial prepayment.

One of the first papers in the literature history of mortgage valuation is the one of Findlay and Capozza (1977) which addresses the valuation of a default free mortgage by means of option replication. Prepayment is modelled as a function of the difference between the mortgage rate and the current refinancing interest rate. Dunn and McConnell (1981) and Brennan and Schwartz (1985) also use the default free setting, but apply a simulation model to determine the value of prepayment. The first research only allows for optimal prepayment in case the mortgage rate exceeds the refinancing rate. The latter elaborates on a two-factor model of prepayment, also allowing for other reasons of prepayment. The default feature of a mortgage was first discussed in a broader framework of the valuation of convertible bonds. Merton (1974) modelled default as the positive difference between the face value of the loan and the house price, only occurring at

maturity. From that moment on, option valuation became the most widely used technique to determine the influence of prepayment and default to the lender. Kau et al. (1993) and Schwarz and Torous (1989) were the first who recognized the correlation between default and prepayment and were able to model this.

The approach of option technique to model a mortgage contract is frequently applied, with options to default and prepay depending on the house price and interest rate.

The special nature of the popular Dutch mortgages requires more than just straightforward valuation methods and necessitate to thoroughly evaluate the prepayment and default features. The international researches do not properly account for the restricted prepayments in the Netherlands. The first exercises on the restriction of prepayment of Dutch mortgages were done by Van Bussel (1998), Alink (2002) and Charlier and Van Bussel (2003). Possibilities to prepay are restricted, usually to a maximum amount of 10-20% of the initial mortgage loan per year. Partial prepayment over that ratio or full prepayments, except those related to a death or a movement, are only admitted by paying an additional prepayment penalty. This penalty compensates the lender for the yield difference and the administration costs. Transaction costs and the prepayment penalty are found to be significant for the unexplainable non-prepayments. Furthermore, macro-economic factors were found to be significant determining prepayment ratios.

Kuijpers (2004) concludes in his description of the mortgage market in the Netherlands that the prepayment risk is by far the most important factor in explaining termination behaviour of Dutch mortgagees. Furthermore, Kuijpers found that Dutch mortgage rates are usually negotiated for longer time periods. This result might be overstated due to the relatively low interest rates in the past ten years. According to his research, the negative effects of a default by the borrower are not large. Therefore Kuijpers does not include this in his valuation model. The reasoning behind this finding relates to the government guarantee in case of a default, which ensures the mortgage lender to receive the face value of the loan. The "Nationale Hypotheek Garantie" (NHG) works as a price distorting mechanism since banks only have to hold half of the usual required capital and borrowers do not pay an additional premium on the mortgage rate for their lower affordability.

5.2   The valuation model for the Dutch mortgage market

By setting out the different characteristics of the Dutch mortgages in the previous paragraph, the model can be explained. Like other financial products, the mortgage can be replicated by a portfolio of other financial products. In this case, a Dutch mortgage can be replicated by a combination of zero coupon bonds, an option to default and an option to prepay.

The value of the mortgage is obtained by multiplying the value under prepayment by the probability of prepayment and adding the probabilistic value under continuation.

The value of the mortgage to the lender, V , is an adapted formula, based the models of Kau and Slawson (2002) and Charlier and Van Bussel (2003):

$$V = h_{it}(F_t + T^*) + (1 - h_{it})(RP_{it} - P_D + PV(F)) \tag{1}$$

where h_{it} represents the hazard rate of prepayment and $F_t + T^*$ gives the value of the mortgage to the lender in case of prepayment, consisting of the sum of the face value of the loan, F_t , and the prepayment penalty, T^* , including transaction costs. The second term represents the value under continuation, given by the difference between the present value of the remaining payments, RP_{it} , and the value of the put option to default before the next payment date, P_D . $PV(F)$ represent the present value of the loan value, which will be received at the end of the duration of the mortgage. The face value is discounted against the risk free interest rate.

5.2.1   The hazard rate of prepayment

The first component of the valuation formula is the prepayment value. In the last years various researches are conducted to interpret and explain the behavior of borrowers in case of a prepayment of the loan.[28] Traditional literature suggests that prepayment only occurs if the current interest rate is sufficiently lower than the contract rate, taking into account possible prepayment penalties and transaction costs. Kuijpers and Schotman (2006) provide a valuation framework for valuing mortgages with an option to prepay. Explicitly saying that they only account for optimal termination based on interest rate changes, assumes that also suboptimal prepayment exists. Alongside this established reason for prepayment, research of Deng, Quigley and Van Order (2000) proved that theoretical estimates based on the most straightforward option model deviate from field observations concerning prepayment rates. Mortgagees seem to make suboptimal decisions regarding prepayment, meaning that loans are not always and not only

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[28] See LaCour-Little (1999); Archer, Ling and McGill (1995); Hayre (2003);

prepaid if the actual interest rate is sufficiently below the contracted rate to cover switching costs. Suggested explanations for this phenomenon, which all come down to the heterogeneity among borrowers, are developed and modeled during the last decade. Other variables, beside the interest rate, that influence prepayment decisions are divorce rates, age of the head of the household, unemployment rates and income-to-housing costs ratios.

Strictly speaking, two ways of modeling prepayment risk have gathered attention.
The first set of models uses contingent claim technique to model optimal prepayment. The value of the option to prepay then depends on the stochastic process of the interest rate.

The second set of models treats prepayment exogenously and thereby takes into account suboptimal prepayment. The exogenous models can be separated into two categories. The first category is based on endogenous models and adds to that a series of call options for suboptimal prepayment. The value of such a call option is driven by an exogenous variable, not being the interest rate. Both processes are combined in the partial differential equation.

Green and Shoven (1986) were one of the first who used the approach of a proportional hazard model to describe prepayment of mortgages. This model does not make a difference between optimal and suboptimal behavior, but instead uses a set of explanatory variables which determine the possibility a certain mortgagee will prepay his loan. Charlier and Van Bussel (2003) extend and adapt this model to fit to the specific characteristics of the Dutch mortgage market and described thereby the prepayment behavior of mortgage borrowers in the Netherlands. In this paper, the model of Charlier and Van Bussel is used to estimate the prepayment value.

The model describes the hazard rate, h_{it}, indicating the probability of full prepayment as:

$$h_{it} = h_0(age_t; \upsilon_1, \upsilon_2) * \pi(x_{it}; \tilde{\upsilon}) \tag{2}$$

where h_0 is the hazard rate for a mortgage of a certain age_t. This variable depends on the hazard rate for a mortgage originated just before, υ_1, and υ_2, which indicates the change of the hazard rate if the mortgage ages. This relation is S-shaped: the hazard rate increases with the age of the mortgage until it has reached a certain steady state.
This is visible in the following formula:

$$h_0(age_t; \upsilon_1, \upsilon_2) = 1/(1 + e^{(-\upsilon_1 - \upsilon_2 * age_t)}) \tag{3}$$

Although υ_2 did not appear to be of significant influence in the model of Charlier and Van Bussel, we include it in the model of our research because there is a clear cut explanation for the variable. Furthermore, other researches perceive the aging effect as important. We use the estimated coefficient of Charlier and Van Bussel.

The variable υ_1 is an independent and constant term. The value of υ_1 is estimated, using the mortgages that were originated at last 3 months, using an average age of the mortgagee. It is assumed that the change of other variables did not have a large impact on the possibility of prepayment. The 200 selected mortgages have an average possibility of prepayment of 0.18. We use this number for υ_1.

The second term in equation 2, the proportionality factor, includes the other variables. This term is solved according to the following formula:

$$\pi(x_{it};\tilde{\upsilon}) = e^{(-e^{(-\sigma'*x_{it})})} \tag{4}$$

This notation implies the use of a vector model. The variables in the vector are again, based on the research of Charlier and Van Bussel. The dependent proportionality π is explained by a set of independent variables, x_{it}. σ represents the according change of the hazard rate. The vector x_{it} contains the explanatory variables of the refinancing initiative, the age of the mortgagee, the income-to-cost ratio and the value of the option to default.

The first, *refinance incentive*, describes the tendency of an existing mortgage to be prepaid if the current interest rate is below the contract rate. The lower the interest rate, the higher the refinancing incentive and therefore the probability of prepayment. A mortgagee should always account for the prepayment penalty if he considers prepaying. Usually, a mortgagee can only prepay a certain amount without being fined. In the research, we assumed a yearly free prepayment of 10% of the original mortgage loan. The penalty is dependent on the difference between the current and the contracted interest rate and the remaining fixed rate period. If this time is only short, the opportunity costs of prepayment and paying the penalty are large, because within a short time, the current interest rate will apply to the contract.

Besides the penalty to compensate the mortgage banks for the loss of future interest revenues, fixed switching costs of 250 Euros are assumed. The penalty is tax deductible. Because we lack data about individual income tax rates, we use 31% as an assumed average tax rate on income from labor. For a detailed elaboration on the calculation of the prepayment penalty and the refinancing incentive, we refer to the research of Charlier and Van Bussel.

In absence of the refinancing incentive, house sales are the main driver of prepayment. There are various variables that influence house sales, like the age of the mortgagee, the type of property, a change in the income-to-cost ratio and the period of the year. The research of Charlier and Van Bussel describes all variables, except the income-to-cost ratio, but only finds the age of the mortgagee and the period of the year (December) as influencing house sales significant. Both variable seem to influence house sales in a positive way.

During the year, moving-up seems to be the most important for the home sales during a certain year. Home sales are primarily dictated by the desire to move to a bigger or more expensive house. Upgrading is expected to be most likely by people who are in their 30's-40's. Charlier and Van Bussel therefore also included square age as an explanatory variable, but this did not appeared to be significant.

Additionally to the research of Charlier and Van Bussel, we introduce the micro-economic factor of the change in the income-to-costs ratio as an independent variable influencing the prepayment probability. Incorporation of other factors is not rare: Archer, Ling and McGill (1996) include house prices as one of the determining variables, since it is reasonable to assume that prepayment and refinancing is hampered if house prices decreased after the origination date. We do not use the house price as an explanatory variable because it already influences the value of prepayment. The motivation behind the integration of income-to-housing cost ratio is two-folded. On the one side, logically, if this ratio changes significantly, borrowers will reallocate their income and spend more/less on housing consumption. This can only be achieved by changing the borrowed amount or the interest rate or by moving, and thus subsequently prepaying the current mortgage. On the other hand, especially this variable is influenced by the proposed tax reform. Not the interest rate, but the costs of housing will change because of the abolished deduction of interest payments on mortgages. To measure the effects of the change on the value of a mortgage, it should be incorporated in the model.

Due to a lack of information about the income-to-cost ratio attributed to the single mortgages, we were eventually not able to include this variable in the research. Hereby, we are not able to express the risk related to a sudden increase of housing costs because we do not know the impact of this increase to the single borrower.

An in-sample estimation technique would be most appropriate to estimate the coefficients. The data set used for estimating should contain both prepaid mortgages and not-prepaid mortgages. One of the drawbacks of this method is the amount of mortgages needed, which should be large in order to obtain reliable results in both the estimation of the coefficients and the calculation of

the results. Also the characteristics of the mortgages in the both subsets should be comparable. The outcomes of the in-sample estimation of coefficients are used to calculate a before and after reform prepayment ratio of the mortgage.

Estimating the coefficients the way described, would involve some work. Therefore we choose to use the coefficients from the research of Charlier and Van Bussel. Regarding the composition of the sample (prepaid vs. not prepaid) the data set of the Rabobank contains about 83% not prepaid mortgages, while the prepaid mortgages contribute for about 17% to the total data set. These percentages are about equal to the sub data set of interest only mortgages of the research of Charlier and Van Bussel. The research of Charlier and Van Bussel is accomplished using loans originated between 1989 and 1999 with an average time since origination of 24 months. Hereby, the average time since origination is substantially shorter than in our subsample. Furthermore, the average age of the mortgagee (divided by 10) is 4.53 in the research and 4.85 in the data set and the average refinancing incentive in the data set is 1757.42 Euros, compared to an average incentive of 1647 Euros in the research op Charlier and Van Bussel. This difference might be caused by the fact that Charlier and Van Bussel accomplished their research in 2000, when the mortgage interest rate was above the current mortgage interest rate. On the other hand, between 2003 and 2007, mortgage rates were historically low. Therefore, it is less likely that those mortgages have a positive refinancing incentive in our data set.

If the coefficients of the explanatory variables are determined, the formula can be extended to calculate the prepayment probability of every loan in the portfolio.

5.2.2 The value under continuation

The second part of formula (1) corresponds to the value of the mortgage if it is not prepaid. It is calculated as the probability of continuation times the value under continuation. For the probability of continuation, we refer to the previous paragraph. The value of continuation consists of the present value of the future interest and repayments, but also accounts for the possibility the mortgagee will default in the future. Default is perceived as the risk that a certain mortgagee will not fulfil its payment schedule and the contract is liquidated. This formula does not account for late payments and foreclosures. The possibility of default is calculated as an option, which has a minimum value of zero to the borrower. The position of the lender is reversely related wherefore the option to default lowers the value of the mortgage to the lender.

The underlying asset of the option to default is the house price. Assuming fixed interest rates and zero transaction costs, the position of the homeowner can be replicated by the combination of a long position in the house, a put option on the house with the strike price equal to the loan value and the loan. The loan value should be equal to the sum of the house price and the price of the put option (administration costs). The put option is incorporated in the mortgage contract and gives the homeowner the possibility to sell the long position in the house for the predetermined strike price. Hereby he gets rid of the house and the loan, independent of the values of both. The homeowner will exercise the option when the house price is sufficiently below the strike price/ loan value. It is assumed that the sale of the house to the bank, releases the borrower from all its obligations, regardless the height of the proceeds of the sale to the bank. This is an important assumption, because the risk of a lower house value is hereby transferred to the lender and no debt obligation remains. Dutch mortgage contracts usually do not contain such a clause. Instead, the borrower, has a liability to the lender to pay off the total mortgage amount. Because a borrower will often be due on the payments, the lender often perceives this as a loss.

The option to default is a European option, because the utility obtained from living in the house is maximized when you default only immediately before the payment date. The option is also classified as a compound option because by not exercising the option and paying the monthly receipts, the mortgagee receives a new option to default on for the next month.

The valuation of options took a big step forward with the publication of Black and Scholes (1973). In their model of option valuation, the value of the option does not depend on the risk attitude of the market. Only the possible future values of the underlying stock determine the value of the option, since this a derivative asset. The model was designed in a way that a closed-end option value could be calculated without the previous techniques of backward or binomial tree calculation.

The initial model of Black and Scholes inheres some assumptions wherefore it is not applicable in all situations. The Black and Scholes model for instance assumes:

1. a lognormal distributed underlying variable;
2. no payments from the underlying asset in the meantime;
3. continuous trading and no arbitrage opportunities, and;
4. a constant short term risk free interest rate.

The assumptions of the initial Black and Scholes model are relaxed in later papers. An overview of this literature is given in Bakshi et al. (1997).

Transferring the framework of Black and Scholes on stock valuation to a mortgage contract, the source of risk that determines the value of the option is the house price. The situation is slightly different from the valuation of a normal stock option since the underlying uncertain factor, the house price, is not as tradable as an stock of a listed company. In this sense, also the assumption of continuous trading is not entirely valid. But since the house can be sold and the market is transparent, we rely on the assumption of Black and Scholes. Furthermore, the interest rate risk deserves special attendance. The value of the option to default in the future is dependent on the expected term structure of the interest rate. As we know from Black and Scholes, an option increases in value when the variance of the underlying asset is high, because the option can not be worth less than zero. Mortgage banks faces the risk of offering a fixed low interest rate for a long period and being confronted with high opportunity costs when the interest rate and the inflation increase.

Especially as a result of the complications with the term structure risk, the literature suggests different valuation techniques for valuing a mortgage portfolio. The most appropriate method has been to solve the partial differential equation by means of backward calculation. Hereby, the value of the option at time $n-1$ is dependent on n and so on. For a detailed description of this way of option valuation, we refer to Dunn and McConell (1981), Epperson et al. (1985) and Kau and Keeman (1995).

We choose to use the Black and Scholes framework for the valuation of the default option on the mortgage. This is by far the most easy way of option valuation. The most important drawback is that it does not take into account the risk of a sudden interest rate increase.

This is of less importance because the interest rate risk is already accounted for in the prepayment model. Furthermore, in terms of comparing the values of the mortgage in 2 different situations, the interest rate (which is important to the mortgage bank) does not change with the change of the tax system.

According to the model of Black and Scholes, the value of an European put option is equal to:

$$p = Ke^{-rT} N(-d_2) - S_0 N(-d_1)$$

(5)

Where

$$d_1 = \frac{\ln(S_0/K) + (r + \sigma^2/2)T}{\sigma\sqrt{T}}$$ (6)

And

$$d_2 = \frac{\ln(S_0/K) + (r - \sigma^2/2)T}{\sigma\sqrt{T}} = d_1 - \sigma\sqrt{T}$$ (7)

Hence, the value the put option is never below zero. K represents the current loan value as the strike price of option, while r represents the risk free interest rate. T is the remaining time to expiration and $N(x)$ is the cumulative probability function for a standardized normal variable. Furthermore, S_0 corresponds to the current value of the underlying asset and σ is the standard deviation of the house price, measured in years.

We assume a risk free interest rate of 3.6%, equal to the 10-years government bond rate on January, 2009. For the calculation of the standard deviation, we used the data of the Dutch Federation of Real Estate Agents. From the quarterly house price movements, measured from 1985 to 2008, a yearly standard deviation of 4.55% is calculated.

Since we measure the value of the option to default on the next payment date, T is set equal to one.

5.2.3 Value after tax reforms

Chapter 4 describes the new system of taxation, which will influence various variables in the model. First, the research of tone he CPB predicts a decrease in the house price of 4.5% to 13.5%, dependent on the length of the term over which household considers the impact of the measure, the interest rate and the assumed average tax rate on income on labor. A scenario analysis is performed on a decrease of the house price of 4.5%, 9% and 13.5%.

Besides the exogenous change of the house price, the tax subsidization on mortgage payments and other costs related to the mortgage are eliminated.

Furthermore, the income-to-costs ratio will decrease as a result of the increasing housing costs. Because we lack all data about the income of the mortgagees, the impact of this change will not investigated in this research.

6. Data

In the empirical research, a real world mortgage portfolio is valued at two different moments; under current circumstances and taking into consideration the new values of important variables that will occur after a change of the tax system. The new values of certain variables are derived from the various researches described in section 4.

The research considers the impact of tax reforms on a particular portfolio of Dutch mortgages. Besides prepaid mortgages, we obtained a portfolio of 10,000 existing mortgage loans for first homes from the Rabobank. The mortgages are randomly selected out of all contracted mortgages of the Rabobank. All mortgage loans have an underlying collateral located in the Netherlands. We only consider fixed rate, interest only mortgages. Due to the lack of certain variables for some mortgage contracts, only 6,165 left for the research. Most of the deleted contracts did not contain information about the market value of the collateral at a certain moment.

The mortgage loans are originated in the period between September, 1978 and December, 2008. The average time since origination, calculated on January, 1st, 2009, is 71 months. Hereby, the average mortgage is originated in February, 2003. This means that, the average contract was originated after the large house price increases in the period from 1995 to 2002. About 33% of the mortgages was originated during the last 3 years.

The mortgage amount is on average 102,018 Euros and the maximum 1,285,000 Euros. This is far below the average mortgage amount of about 165,000 Euros in 2006.[29] As stated in an interview with the Rabobank[30] they perceive themselves as a mortgage lender to middle-class households which might explain the lower average mortgage amount. Lower-class households do not own but rather rent a house, while the upper-class households have their mortgages at other mortgage banks. Only 13% of the mortgages has an mortgage value over 200,000 Euros. The average amount seems to be low. This might be caused by the time since origination. The mortgages with an mortgage amount under 200,000 Euros (87%) are on average originated 6 years ago, while the mortgages with a mortgage amount over 200,000 Euros are originated only 3.5 years ago. When time passes, house prices tend to increase. Hereby, home owners created home equity.

Furthermore, the average interest rate on the mortgage is 4.8% with an average fixed rate period of about 11 years. About 97% of the mortgages has a fixed rate period of 5 years or more and even 73% has a fixed rate period of at least 10 years. It is hard to compare those figures to Dutch

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[29] Meijer, B., 2007, "De Nederlandse conjunctuur-2007", aflevering 2, CBS
[30] Interview with Mr. Pietersen, head of the department Long Term Lending Products of Rabobank Nederland

averages, since 15% of the Dutch mortgages has a variable interest rate, while this research contains no variable interest mortgages. The mortgages with an fixed interest period of at least 20 years, are on average originated 4 years ago with an average interest rate of 5%. Here we see that the mortgage loans with long fixed rate periods are initiated just after a period of high interest rates in the late nineties and early 2000.

The average time to the end of fixed rate period is rather shorter: about 7 years. This implies that interest rate changes only have an effect in the longer term.

The loan-to-value ratio is calculated by dividing the current loan value by the house value on January, 1st, 2009. For the greater part of the mortgages, only the value at the time of origination was available. In order to obtain the current market value of the property, the NVM house price index is applied to that value in order to accurately estimate the value on January, 1st, 2009. The average loan-to-value ratio of the mortgage portfolio is 0.38. This is about the average Dutch LTV-ratio. For mortgages originated in the last 5 years, this ratio amounts 0.47. Hereby, the mortgage portfolio does not seem to correctly display the average of Dutch mortgages. Only 7% of the mortgage contracts has a loan-to-value ratio over 1,00. These mortgages are characterized by an average period from origination of 3.5 years and an average fixed rate period of more than 12 years, an average mortgage amount of about 224,000 Euros and an average interest rate of 4.7%. We have to consider that the amount of mortgages with an LTV-ratio over 100% is barely represented in this research. The Rabobank perceives itself as a conservative mortgage bank which did not go in front in providing mortgages with high LTV-ratios. Rabobank is especially careful with interest only mortgages. Because the average LTV-ratio is likely equal to the Dutch average, the total outcome to the banks will be correctly predicted. Only the impact to the personal mortgagees will be underestimated.

Due to the fact that certain characteristics of the studied mortgages are not similar to the averages of the Dutch mortgage market, it will be hard to apply the results of this research to the total Dutch mortgage market. Furthermore, this research studies only a particular mortgage contract, that is the fixed rate, interest only contract.

The data set lacks data about gross household income as well as about the type of property. The lack is caused by the fact that the income information is not supplied by the Rabobank. The other information is unavailable to the Rabobank.

7.   Results

This section presents the results of the valuation of the mortgage portfolio, both with and without tax subsidization of mortgage costs. Furthermore this section compares the outcomes of the valuation and concludes on the impact of a possible tax change.

7.1.   Value of the mortgage portfolio under the current tax system

By means of the method expressed in section 5 and 6, the mortgages are valued under the current tax system at January, 1st, 2009.

In order to obtain the value of the mortgage, first, the refinancing incentive, the possibility of prepayment and the value of the option to default are calculated.

The average refinancing incentive under the current tax system amounts to about 880 Euros. Chart 8 shows the development of the average refinancing incentive dependent on the remaining fixed rate period. The red line shows that the refinancing incentive first increases with the remaining fixed rate period. Since a mortgage can be refinanced without penalties at the end of the fixed rate period, it becomes less interesting to refinance the mortgage and pay the prepayment penalty when the end of the fixed rate period approaches. For mortgages with an remaining fixed rate period of more than 10 years, the refinancing incentive decreases again. This is caused by the fact that the contracted interest rate on those recently originated mortgages is relatively low, compared to the current interest rate.
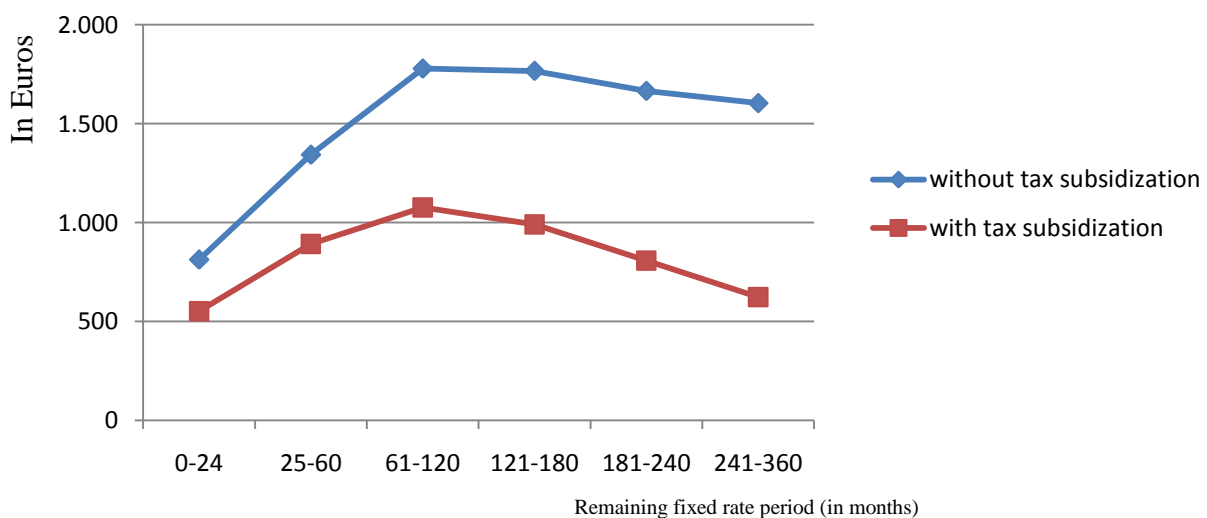

Chart 8: Overview of the average refinancing incentive for different remaining fixed rate periods under both circumstances

Valuating the mortgage portfolio for the bank, the average value of the mortgage appeared to be 140,786 Euros, compared to an average loan value of only 102,034 Euros. The difference between these amounts is the compensation to the mortgage bank for the risk of prepayment and default. Although assumed, chart 9 shows that there is no clear relation between the difference between the market value of the loan to the bank and the face value (corrected for the size of the loan) and the risk of the loan as measured by the LTV-ratio. We expect to see a positive relation between both variables, but instead, the trend line of chart 9 is decreasing. Although not statistically proven, the relation shown is expected to be caused by the interest rate. The higher the interest rate, the larger the difference. Mortgage loans with a low LTV-ratio are frequently originated a long time ago, when the interest rate was higher than in recent years.
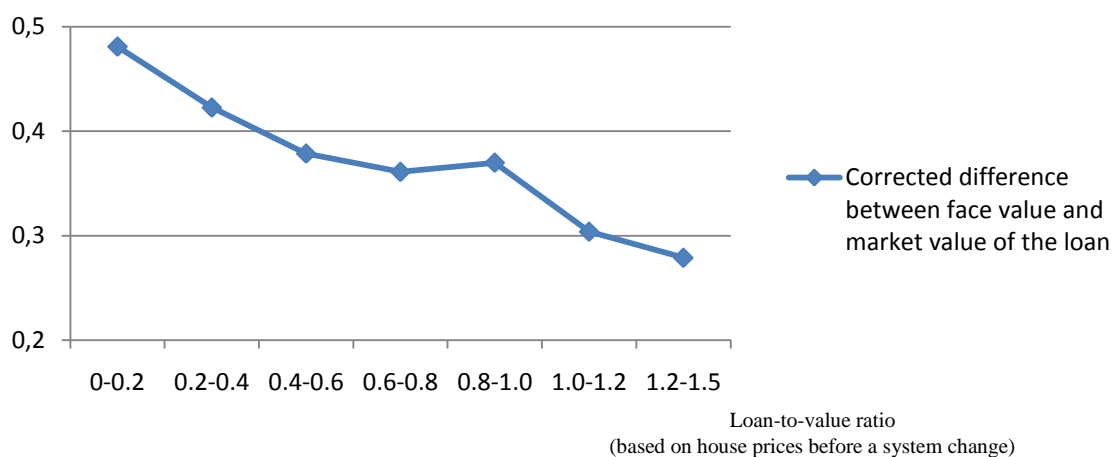

Loan-to-value ratio
(based on house prices before a system change)

Chart 9: Relation between the corrected difference between the both values and the loan-to-value ratio

7.2. *Value of the mortgage portfolio under the new tax system*

As a result of the change of the tax system, the after tax interest costs on the mortgage increase. Since we did not include the income-to-costs ratio in the analysis, the cost increase only influences the refinancing incentive. Hence, for the mortgagee, the increase of the after tax costs also influence the present value of the remaining interest payments. We only take into account the position of the bank, which does not change.

Because the prepayment penalty is no longer tax deductible, it will be more expensive to prepay the mortgage. On the other hand, the change of the tax system widens the gap between the current mortgage rate and the contracted rate, since this is also calculated without tax deductibility. This has a positive impact on the refinancing incentive.

The net effect of the tax change on the refinancing incentive will therefore be dependent on the difference between the contracted mortgage rate and the current interest rate. The larger the difference (positive) the larger the possibility on a positive impact on the refinancing incentive. On average, the refinancing incentive increased from 880 Euros to 1456 Euros. Chart 8 shows the refinancing incentive for different remaining fixed rate periods. The refinancing incentive after the tax change shows the same pattern as before.

The number of mortgages with a positive refinancing incentive increased from 1,888 to 1,921.

Besides the refinancing incentive, also the value of the option to default is expected to increase. This is displayed in chart 10 for a house price decrease of 9%.
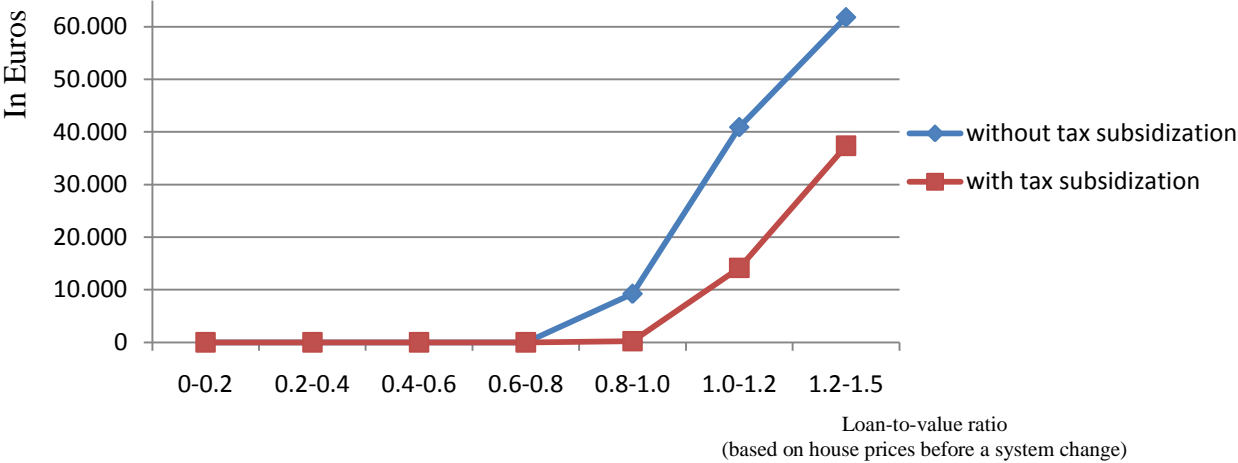

Chart 10: The value of the option to default, for different LTV- ratios, under both circumstances

The value of the option to default is driven by the difference between the house value and the face value of the loan. Due to the tax change, this difference is expected to increase. Unlike the trend displayed in chart 10, there are mortgages that increased in value after the change of the tax system. Those mortgages are characterized by a (small) positive refinancing incentive in the situation with mortgage subsidization, while the refinancing incentive is zero in case of the new tax system. This is caused by the elimination of the tax deductibility of the prepayment penalty. In some cases, the refinancing incentive decreased from about 50% to 20%. This has a negative effect on possibility of prepayment. Since the value under continuation is usually higher than under termination, this influences the value of the mortgage positively. Furthermore, the loan-to-value ratio of those mortgages is low, whereby the value of the option to default in both circumstances is nearly zero.

7.3 Change in the value of the mortgage to the bank

Chart 11 shows the change in value of mortgages with a different LTV-ratio for various expected house value decreases. The lines indicate the average value of the mortgage for different LTV-ratios. As expected, mortgages with high LTV-ratios are more vulnerable for changes in house prices and will therefore decrease more in value than others. As shown in chart 11, the tax system change barely influences the value of mortgages with a LTV-ratio less than 0.8. Also the positive impact on mortgages with low LTV-ratios is visible.
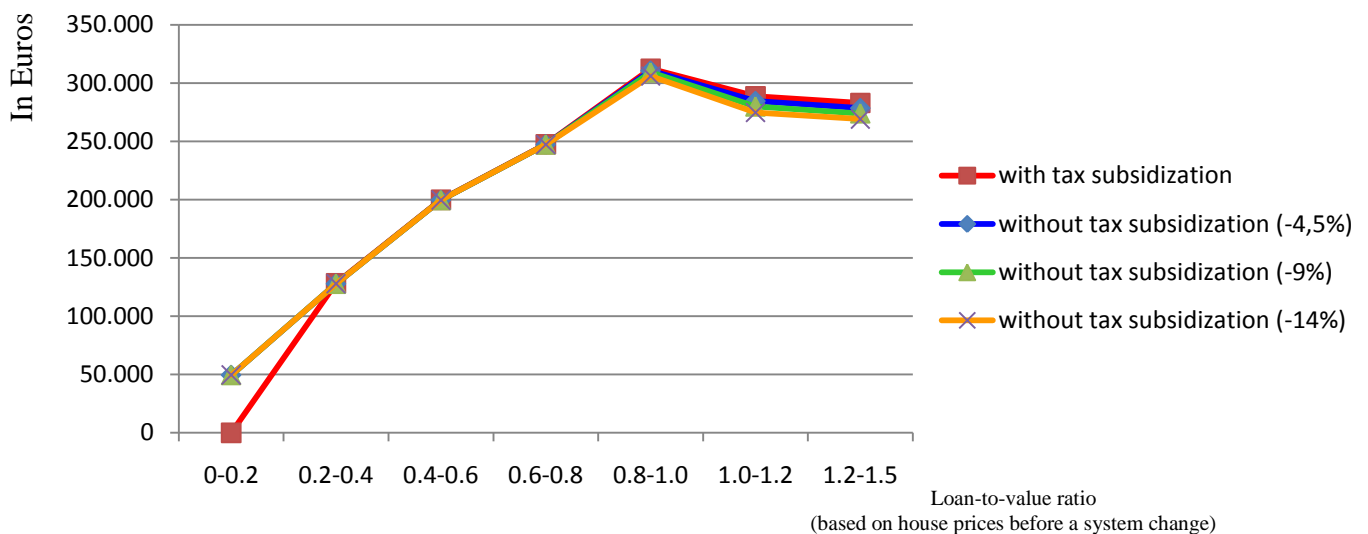

Chart 11: The value of the mortgages under both circumstances, for different LTV-ratios

Chart 11 shows that especially the mortgages with high LTV-ratios are a risk to the bank. The mortgages with a LTV-ratio over 1.0, about 10% of the total amount of mortgages, face a decrease of 3-10% of the initial value, dependent on the assumed house price decrease.

In order to more thoroughly understand the value changes of those mortgages, table 2 gives an overview of the value change of the 25% most decreasing mortgages. As shown in table 2, only 5% of the mortgages (308 mortgages) faces a value decrease of more than 4,583 Euros (with a 4.5% house value decrease). The maximum decrease, independent of the house value decrease, is 119.849 Euros. Table 2 shows that the loss of the 5th percentile increases when the house price decrease becomes worse. The average decrease in that situation amount 13,920 Euros.
We see that expecially the mortgages with high LTV-ratios are vulnerable. The average decrease of the total mortgage portfolio only amounts 0.4-1.1%. A lot of mortgages do not change in value because the refinancing incentive stays zero and the value of the property is far above the face value of the loan.

Change of mortgage value	House value -4,5%		House value -9%		House value -14%	
Highest	€	-119.849	€	-119.849	€	-119.849
Average	€	-609	€	-1.012	€	-1.573
Lowest	€	124.279	€	118.212	€	110.960
5th percentile	€	-4.583	€	-8.736	€	-13.920
10th percentile	€	-1.196	€	-2.331	€	-3.977
15th percentile	€	-89	€	-208	€	-441
20th percentile	€	-2	€	-6	€	-20
25th percentile	€	-0	€	-0	€	-0
Average change as a % of the total value	-0,4%		-0,7%		-1,1%	

Table 2: Overview of the impact of a system change on the average value of the mortgage portfolio, for different loan-to-value ratios

8. Conclusion

Banks have reacted furiously to the possible elimination of the interest deductibility of mortgage interest. They feared a total collapse of the housing market due to defaults on mortgages , decreasing consumer confidence and eventually leading to decreasing house prices.

Although not completely comparable, banks partly found their right in the housing market bubble in the US. As a result of risky lending practices of US mortgage banks, the interest rate increases and growing unemployment rate led to double-digit house price decreases for various quarters in a row.

By means of a valuation model, that includes both the option to prepay and default, the statements of the banks are examined on their reliability. The value of the mortgage is dependent on the age of the mortgage and the age of the mortgagor. Furthermore, the loan value, the value of the property and the interest rate influence the value of the mortgage.

Maybe even more important than the interest rate, the difference between the contracted mortgage rate and the current market interest rate, influence the mortgage value. This difference is calculated in the refinancing incentive. The refinancing incentive appeared to be an important variable in explaining the value change of the mortgage in case of a tax change. On one hand, the refinancing incentive is lowered because the penalty that is indebted in case of prepayment, is no longer tax deductible. On the other hand, the difference between both interest rates increases because it is no longer tax deductible either. This increases the incentive to refinance.

Also the option to default is an important variable. The option to default depends on the difference between the loan value and the house price. As long as the value of the property is higher than the face value of the loan, the mortgagee has no incentive to default. As the value of the property is expected to decrease as a result of the tax change, the value of the option to default is expected to increase.

The research showed that, overall, the mortgages in the dataset decreased in value by 0.4-1.1%, dependent on the assumed house price decrease. This does not seem to be the destructive influence that banks warned for. On one hand, this might be caused by the low risk profile of the mortgage portfolio used in this research. On the other hand, various researches predict that the devastating consequences of a tax change are especially visible for mortgages with high LTV-ratios. Those mortgages are vulnerable for the change in the option to default. The thesis also draws this conclusion. The 10% -mortgages with the highest LTV-ratio, the mortgage value changed on average by 3-10%, depending on the assumed house price decrease.

As became clear from the investigation of tax changes in Sweden and the UK, the impact of the tax change is highly dependent on the current conditions of the economy, the housing and mortgage market. The research is conducted taking into account the circumstances as per January, 1st, 2009. As we all

know, the economy faced a serious downturn during the last few months. A further investigation of the impact of the tax changes seems to be reasonable in order to determine the maximum risk to the banks.

Furthermore, we recommend banks to further investigate the risks attributed to a tax change. In the contacts we had with the Rabobank, it became clear that the bank conducted some research itself to the consequences of a possible tax change. The risk management of mortgages with high LTV-ratios should be an important topic of consideration. We further recommend to include the income-to-cost ratio in the analysis. Due to a lack of data, we were not able to include this into the research, but it is argued to be an important variable in explaining the prepayment of mortgages.

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Appendices

Appendix 1: The data set

The data set contains information about the mortgagee, the mortgage and the collateral.

Variable	Definition
GEB_DTM	Date of birth of the head of the household
ING-DTM	Date of origination of the mortgage loan, denoted in year-month-day.
ORSPR_H36	Original amount borrowed, denoted in Euros
RNT_VSTt41	Fixed rate period at the origination of the mortgage loan, in months.
END_LPTD 35	End of the duration of the loan, year-month-day.
RST_HF47	Outstanding loan value as per January, 1st, 2009, in Euros.
RNT_PCT_1	Effective yearly interest rate applicable to the mortgage contract.
WRD_DTM	Date of the last taxation of the collateral, in year-month-day.
EXE_WRD31	Liquidation value of the collateral, in Euros.
VVERK_W32	Market value of the property, free of renting obligations, in Euros.
HYP_INS35	Height of the maximum registered mortgage amount, in Euros.
SCHULD_37	Number of borrowers on a certain mortgage.
RG_AANT	Number of properties as collateral.
HYP INS SOORT CODE	Type of mortgage loan, indicating the status of the bank in case of a default/ liquidation, B = bank mortgage (=highest priority); RCB = rectification bank; V = fixed mortgage; RCV = rectification fixed; VVL = collateral fixed after sale and delivery; P = positive/ negative pledge; NV = notarial authorization.
GESL_CD	Gender, M=male; V=Female.
HYP_IND	Collateral available, 1= Yes; 2=No
BESTED_33	Goal of the mortgage; 0=reconstruction; 1=Construction/purchase real estate; 2=purchase of other assets (not real estate); 3=business financing
NHG_GMN43	Applicability of the Dutch Guarantee Fund for mortgage contracts, Y=Yes; N=No
AFL_BEDR	Monthly amount of repayment, in Euros
ANNU_BEDR	Monthly payments on interest and repayments, in Euros.
LEN_ST_CD	Status of the mortgage loan, A=Active; I=inactive.
AFSL_PR44	Lock up revenues of the mortgage bank, in Euros
CUST_NO	Customer number

Besides the above described information, the data set contains the contact details of all the mortgagees. Also the location of the property is given.

Appendix 2: Calculation example of the value of just a mortgage out of the data set

We assume a fixed rate, interest only mortgage with no. 3242 from the data set. The male mortgagee is born on May, 19th, 1976. The property is located in Rhoon, close to Rotterdam. The mortgage is originated on May, 3th, 2004, for an amount of 157,500 Euros. The according fixed rate period is 240 months and the effective yearly interest rate is 4.5%. The governmental guarantee (NHG) is applied to the loan. The mortgage loan is collateralized. The collateral is

valued at March, 18th, 2008 for a total liquidation value of 203,000 Euros. The corresponding market value of the property is estimated on 230,000 Euros.

The calculation of the mortgage value, starts with the calculation of the hazard rate of prepayment.

Prepayment penalty

In order to calculate the prepayment penalty, the yearly interest rate is transferred to a monthly interest rate. A yearly interest rate of 4.5%, means a monthly interest rate of 0.367%. We used data of the CPB[31] in order to determine the current mortgage rate in case of prepayment. The applicable mortgage rate is dependent on the remaining fixed rate period. For this mortgage, the remaining time to the end of the fixed rate period is 184 months. Assuming a free prepayment possibility of 10% of the mortgage amount, the prepayment penalty is -347 Euros. This means that no penalty would be indebted in case of prepayment. This is caused by the fact that the current interest rate for a mortgage with a fixed rate period of 184 months, is 6.1% per year.

Refinancing incentive

The refinancing incentive is calculated as the difference between the costs under continuation and the costs under refinancing.
We use the current interest rate on a mortgage with a fixed rate period of 184 months as the discount rate in order to calculate the present value of the payments.
For the above described mortgage under the described circumstances, the present value of the costs (only interest payments) to the mortgagee under continuation are 111,689 Euros, while the costs of borrowing in case of refinancing, are 128,308 Euros. Both values assume a mortgage interest deductibility of 31%. This means that the refinancing incentive on this mortgage is zero.

The probability of prepayment

The probability of prepayment is determined by the age of the mortgage, the age of the mortgagee, the refinancing incentive, the probability of prepayment of a mortgage used originated before and the year of origination. By applying the coefficients to the values of this mortgage, the probability of prepayment, appears to be 0.34791.

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[31] Westra, P., "Investeringen in woningen", Central Planning Agency (CPB), CPB Memorandum, no. 217, march, 17th, 2009

Option to default

The value of the option to default is driven by the difference between the market value of the house and the mortgage loan and by the standard deviation of the house price. The standard deviation of the house price is 4.5496% per year. The value of the option to default on the next payment date is 2.297 Euros. This value is low because the difference between the market value of the house and the loan value is big.

Present value of future interest payments

We use the continuous compounding formula to calculate the present value of a stream of monthly payments over 304 remaining payment points, since the remaining time to the end of the contract is 304 months. In order to discount the payments, we assumed a risk free interest rate of 4%. The present value of the remaining interest payments on this mortgage amounts 259,526 Euros.

Value of the mortgage

By applying the formulas to these data, the value of the mortgage to the bank, in case of mortgage interest deductibility, is 299,942 Euros.

Due to the negative refinancing incentive en the large positive difference between the market value of the property and the mortgage loan, the value of the mortgage does not change with the proposed tax change.