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Adjustable-rate and fixed-rate mortgages: a study
of default

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ABSTRACT

Buying a house is one of the most important investments that a person makes during his life. In most cases homeowners do not have enough liquidity and take a mortgage to finance it. This text aims at understanding which is the best type of mortgage to use comparing in particular adjustable-rate and fixed-rate ones that are the most common. Moreover, this document tries to analyze how factors such as negative equity, interest rates and loan size influence default and prepayment considering in particular the 2000s and the impact of the housing bubble crash. The option of strategic default is also presented studying the correlation with elements like propension to risk, expectation about the future, attachment and cultural characteristics.

Keywords: mortgage, interest rate, adjustable-rate, fixed-rate, default, prepayment,

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INTRODUCTION

Most of times households that during their lifetime face the decision to buy a house have to decide how to finance it. In fact, the investor not having enough economic availability initially pay a down payment that usually is equal to 20 percent and then applies for a mortgage. The larger the down payment, the greater the risk assumed by the buyer.

The aim of this text is to give some points of reflection in order to select the most appropriate type of mortgage discussing the option of default, prepayment in the case of adjustable-rate mortgages and fixed-rate ones.

In the first part of this research Campbell model, that is used to help homeowner to choose between different type of mortgages, is presented in particular taking into account adjustable-rate mortgage and fixed-rate mortgage.

In the second part, default whose occurrence become more frequent after the housing bubble crash of 2007 is presented. The impact on mortgage default of some factors such as negative home equity, income risk, initial interest rate and loan size are analyzed.

The option of prepayment, that takes place when households that accumulated enough positive home equity decide to sell the property and by repaying the outstanding debt, is also considered.

Subsequently, the text shows the role of loan-to-value (LTV) and loan-to-income (LTI) that are rates that measure respectively the level of risk and the affordability of a mortgage considering how they influence delinquency and cash-out both in the case of ARM and in the case of FRM.

Then, complex mortgages, employed to finance expensive houses, whose utilization become more frequent in the 2000s, are introduced. Following the studies of Amronin and Huang this document examines in particular three types of complex mortgages: Interest Only (IO), Negative Amortization (NEGAM) and Teaser Rate Mortgage (TRM). Income, house value, loan amount, value-to-income, initial interest rate and unemployment are reported on one hand comparing CMs with

ARMs and FRMs and on the other hand considering IOs, NEGAMs and TRMs separately. Moreover, the probability of exercising the option to default, bankruptcy and prepayment are expressed.

In the next section the text talks about strategic default that is defined as the deliberate decision to stop paying back mortgage even if the homeowner has economical availability to continue. Some determinants that affect the choice of default strategically are considered: for example, attachment to the house that is inversely proportional to delinquency, aversion to risk that make people less likely to default strategically, the possibility to become unemployed in the future and expectations about how house prices will vary in the future.

Afterwards, the relationship between delinquency and cultural characteristics is underlined following considering six different contributors that define the cultural profile of a person: is individual versus collectivism, power distance, uncertainty versus avoidance, masculinity versus femininity, indulgence versus restraint and pragmatic versus normative.

Then, delinquency and prepayment in 2000s are analyzed in particular to understand if there is a correlation between the decrease in prepayment and the increase in default during this period.

In the next section the relationship between inflation and interest rates is studied examining the evolution of EURIOR, IRS and inflation from 2003 to 2023.

1. FIXED AND ADJUSTABLE MORTGAGES

The most employed mortgages are FRM and ARM and both present advantages and disadvantages.

Fixed-rate mortgages (FRM) are the most common type of mortgage used. (Thornton & McDonald, 2008)

They could be defined as home loans with fixed interest rate. So, loan payments, composed by principal and interest, remain constant from the beginning to the end and don't fluctuate with the market. The length of the loan could be from 10 to 30 years but the most popular one is 30 followed by 15 years.

The monthly mortgage payment could be calculated as:

$$M = \frac{P[i(1+i)^n]}{[(1+i)^n-1]}$$

where M is the monthly payment, P is the principal amount of the loan, i is the monthly interest rate and n represent the number or months necessary to repay totally the loan. (Kagan, Fixed-Rate Mortgage: How It Works, Types, Vs. Adjustable Rate, 2021)

For example, let's take into account a borrower that applies for a loan of \$200.000 that have a term duration of 30 years with monthly payment. The initial interest rate is set to 2,3 percent and is composed of an EURIRS¹ of 0,86² percent and a spread of 1,45 percent. Considering that in a FRM the rate remains fixed, the payment results to be equal to \$769,60. The total payment is \$277.056 that is composed of \$77.056 of total interest. Figure 1 shows the trend for loan balance, cumulative principal and cumulative interest from the beginning until the end of the duration.

¹ EURIRS (Euro Interest Rate Swap) is measured daily by the European Banking Foundation and is the principal instrument to calculate the interest rate in fixed-rate mortgages. It represents the average interest rate at which the most notable banks use swap. It is dependent on the duration of the mortgage but not on the amount.

² It is used the value of the EURIRS measured on the 13th of September 2022

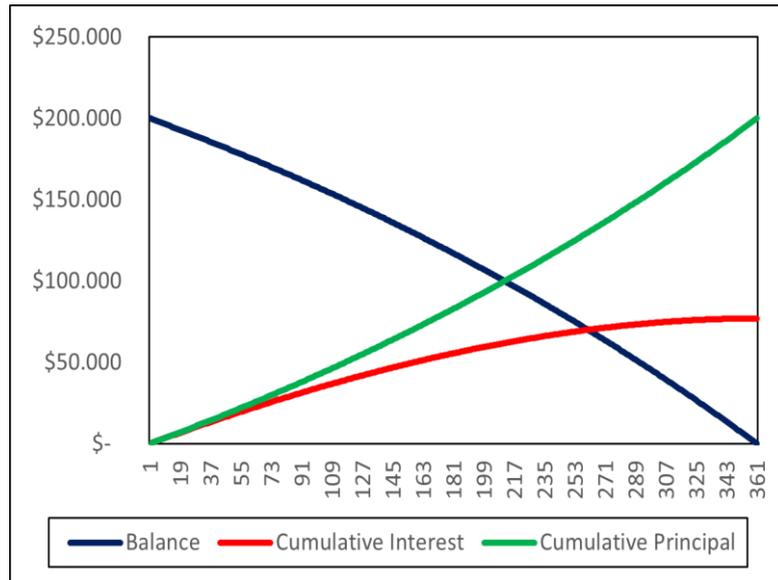


FIGURE 1: SHOWS THE DEVELOPMENT OF LOAN BALANCE, CUMULATIVE PRINCIPAL AND CUMULATIVE INTEREST OF AN FRM (EURIRS VALUE AT 13TH SEPTEMBER 2022 IS USED TO CALCULATE INTEREST RATE).

To be locked in a fixed interest rate have both positive and negative aspects. On one hand it could be good because the investor knows how much he should pay and if the interest rate rises the amount is not influenced. That's why usually this type is chosen by individuals who have not a high tolerance to risk or by those who expect interest rates to rise in the future.

On the other hand, FRM is a risky contract since its value is sensitive to inflation. In a market where the interest rate is falling, borrowers pay more than what the current environment could offer and more than how much could have paid if the mortgage would be stipulated applying the current market conditions. If the FRM has the option to refinance the homeowners is more protected from the wealth risk since he can take out a new mortgage with lower interest rate when it is falling even if in most cases, they have to pay fees.

Usually, households tend to choose FRMs when interest rate have declined since they assume that long-term interest rate follow a cyclic trend and falls are succeeded by increases. Under these assumptions a rational investor prefers to block the interest that is lower than the ones observed in the past and benefit from the fact that in fixed-rate mortgages the payment remains always constant. (Campbell & Cocco, 2003)

The adjustable-rate mortgages (ARM), also called floating mortgages, could be described as home loan with a variable interest rate. Firstly, the initial interest rate is fixed for a specified period at a lower rate than the one offered on an equivalent fixed-rate mortgage and after that it is adjusted periodically (usually every month or every year) and rises or falls according to the fluctuations of the market (Liberto, 2022). Usually in ARMs interest rate caps are specified so that the loan rate cannot go higher or lower than a specified percentage.

For example, let's take into account a borrower that applies for a loan of \$200.000 that have a term duration of 30 years with monthly payment. The initial interest rate is set to 4,1 percent and is composed of an EURIBOR³ of 2,65⁴ percent and a spread of 1,45 percent. Considering that the rate remains fixed for 3 years and then changed with an expected adjustment of 0,250 percent every 12 months, the initial payment results to be equal to \$966,40. The total payment is \$444.218,28 that is composed of \$244.218,28 of total interest. Figure 2 shows the trend for loan balance, cumulative principal and cumulative interest from the beginning until the end of the duration.

Due to the fact that the real capital value of an ARM is not affected by inflation, it can be considered as a safe contract (Campbell & Cocco, 2003). Moreover, generally ARMs present lower initial interest rate compared to FRM that could attract investors (Dolf Dunn, 2014). For this reason, adjustable-rate mortgages are also selected by investors who are not interested in long-term view but have the idea to move after a few years and by people who think that their income will grow in a rapid way in the future or by individuals who expect the interest rates to fall in the future.

³ The EURIBOR (Euro Interbank Offered Rate) is the most important reference in Europe to calculate the interest rate in adjustable-rate mortgages. It can change daily, and it is based on the average interest rate at which the most notable European banks borrow funds.

⁴ It is the Euribor measured on the 13th of September 2022

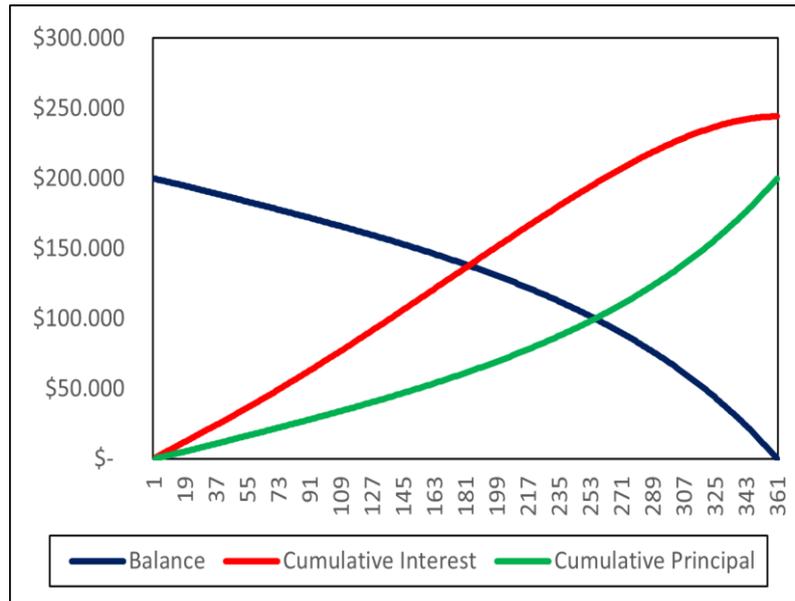


FIGURE 2: SHOWS THE DEVELOPMENT OF LOAN BALANCE, CUMULATIVE INTEREST AND CUMULATIVE PRINCIPAL FOR AN ARM (EURIRS VALUE AT 13TH SEPTEMBER 2022 IS USED TO CALCULATE INTEREST RATE).

However, this type of mortgage has also some disadvantages: first, in an ideal world if inflation grows, the purchasing power, that represents the value of a currency in terms of the number of goods and services that a person can buy with a single unit, should go up in a proportional way. In reality, inflation on one hand erodes the purchasing power and on the other hand increases prices. Inflation makes interest rates grow rapidly but this is not followed by a proportional increase in income and purchasing power. That's why in ARMs if yields rise monthly payments could become very expensive and borrower cannot afford them.

Then, even by using an average of past short-term interest rate as an estimation for the future, it is very difficult to forecast fluctuation rate movements in long-term interval since it depends on several factors and so adjustable-rate mortgages result to be cheaper in the short-run but could become more expensive in the long term. (Arsham, Ford, Morse, & Pitta, 2007)

They are preferred by people who can accept uncertainty and aren't risk averse or by investors who expect interest rate to stay low or go lower in the future. Another important risk of ARM is that if the monthly payments made cannot compensate the

interest rate due for that period, the payment can result in negative amortization and the outstanding balance of the loan can increase. In fact, the accrued interest, that is the difference between the interest and the repayment, is capitalized into the outstanding principal. (Campbell & Cocco, 2003) In a typical mortgage, as long as the person is making payments the principal balance diminishes progressively, but in the scenario of negative amortization the reverse could happen. For instance, considering the previous example, after three years the loan balance is equal to \$188.868,44 and that the monthly payment is \$993,33 where \$685,76 is the interest and the remaining part represents the principal. Supposing that at month 37 the borrower pays only \$500; this payment is not sufficient to cover the interest and \$185,76 are added to the loan balance that increases and become \$189.054,20. Even if negative amortization allows flexibility, it can expose homeowners to not affordable payment in the future since if loan balance increases and future interest rates rise not only the principal outstanding but also the total interest (that is calculated on the loan balance) will increase.

2.CAMPBELL MODEL

Selecting the more appropriate type of mortgage to finance a house is one of the most important choices that a homeowner has to take. The borrower must ask himself if it is better to use a fixed or an adjustable rate remembering that the optimal decision depends on many factors such as the duration, the propensity to risk, the inflation rate and many others have to be taken into account.

In the academic literature the topic of mortgage decision hasn't been studied with the necessary consideration even if some researchers focused on specific features like prepayment penalties or borrower mobility.

Campbell and Cocco in 2003 developed a model that helps people to solve this problem without studying what determines the initial choice of the house but starting the analysis at the moment in which borrowers have to finance it. They widened the work to model the choice between mortgage made by Stanton and Wallace in 1998 taking into account borrower constraints and labor income.

The state variables are age (t), cash-on-hand (x_{it}), inflation (∂_t) that depends on time, real interest rate (r_{it}), real price of the house (P_t^H), the nominal price level (Pl_t), the level of permanent income (v_{it}) that is dependent both on time and on borrower. Moreover, there is a Boolean variable ($D_{term\ ij}^S$) that shows whether the mortgage was previously terminated thanks to prepayment or default and that is equal to one if this happened and zero otherwise. If the type j of the mortgage is FRM there is also an additional variable to indicate if the loan was refinanced or not ($D_{refinan\ ijt}^S$, equal to one if this happened and zero otherwise).

There are also some choice variables: consumption (C_{it}) that depends both on time and on borrower and two Boolean variables ($D_{default\ ijt}^S, D_{prepay\ ijt}^S$) that are used to display respectively whether the household chooses to default on loan j in period t and whether to prepay the loan in period t or not. If the type j in an FRM the model presents another choice variable ($D_{refinance\ ijt}^S$) to identify whether the household refinances the loan and that is equal to zero if this does not happen.

According to the model the utility of household arises both from consumption (C_{it}) and from terminal wealth ($W_{i,T+1}$) that represents the utility that remains at age T+1 and that includes housing wealth and financial one.

The following equation shows household preferences. T is the terminal age, b_i is a parameter to measure the importance of utility from terminal wealth and β_i is set as a discount factor and γ_i is the coefficient of relative risk aversion.

$$\max E_i \sum_{t=1}^T \beta_i^{t-1} \frac{C_{it}^{1-\gamma_i}}{1-\gamma_i} + \beta_i^T b_i \frac{W_{i,T+1}^{1-\gamma_i}}{1-\gamma_i}$$

The lower-case letters identify log variables for example ($p_t = \log P_t$), and the model assume that inflation at a certain period is the same at the one registered from that period to the following one.

Nominal interest rate is formed by two components: expected inflation rate (∂_t) in a certain period of time and ex-ante real interest rate (r_{it}). The nominal interest rate is not fixed but varies over time due to fluctuations of both the components. It is not easy to determine the fluctuations in real interest rate and the inflation forecasts can be applicable in short-term only. In a long-time horizon expected inflation movements have a stronger influence on interest rate.

The nominal yield on a one period can be presented as:

$$y_{it} = r_{it} + \partial_t$$

In Campbell's model real labor income (L_{it}) that household receives in each period cannot be used as a warranty for the loan. The log of real labor income is given by:

$$L_{it} = f_i(t, Z_{it}) + w_{it} + v_{it}$$

It is made up of different parts: a deterministic component $f_i(t, Z_{it})$ that is a function determined by age t and by other characteristics linked to the homeowner (Z_{it}) and two random stocks (w_{it} and v_{it}).

The first one is not permanent and follows an independent and identically distributed normal variable that have mean zero and variance $\sigma_{w_i}^2$. The second one is permanent and is expected to follow a random walk:

$$v_{it} = v_{i,t-1} + \mu_{it}$$

where μ_{it} follows an independent and identically distributed normal variable that have mean zero and variance $\sigma_{\mu_i}^2$.

Concerning house price variation, the model identifies P_t^H ⁵ as the real price of housing in a period t. P_t^H follows a random walk and growth can be written as:

$$\Delta_{p_t}^H = g + \delta_t$$

where g is a constant and δ_t is a normally distributed variable.

Concerning taxes Campbell considers a linear taxation. In particular gross labor income L_{it} and nominal interest y_{it} receive a constant tax rate τ . In each period borrower have to pay tax for the property τ_p that are proportional to the size of the house and a maintenance cost m_p proportional to the value.

The model proposed supposes that the house of size H is financed by borrower thanks to previously accumulated money and the maximum amount of the loan permitted $((1 - d_i)H_i)$ that is equal to the value of the house less a down-payment where d_i is the down-payment. Initial loan amount is quantified:

$$D_{i1} \leq (1 - d_i)H_i$$

Mortgage payments depends on which type of mortgage is selected. The model considers FRM and ARM.

Concerning ARM, the amount of the principal pending at date t is identified with D_{it}^{ARM} and the one-period nominal interest rate with $Y_{1t}^{i,ARM}$. The real payment of the mortgage at date t is given by the following expressions:

$$M_{it}^{ARM} = \frac{Y_{1t}^{ARM} D_{it}^{ARM} + \Delta D_{i,t+1}^{ARM}}{P_t}$$

⁵ $P_1^H = 1$ so H denotes the value of the house at initial date

where $\Delta D_{i,t+1}^{ARM}$ is the part of the mortgage that at date t is used to pay the principal rather than the interest rate. To simplify the model, it is assumed that for the ARM the principal loan repayment $\Delta D_{i,t+1}^{ARM}$ equalize those of FRM.

The nominal interest rate for an ARM at date t is given by the short rate plus a constant premium ($\alpha^{i,ARM}$) that is a compensation for the lender in case of risk of prepayment and default:

$$Y_{1t}^{i,ARM} = Y_{1t} + \alpha^{i,ARM}$$

The real payment of the mortgage of type FRM at date t $M_{it}^{i,FRM}$ is given by the following expressions:

$$M_{it}^{FRM} = \frac{(1 - d_i)H_i}{P_T \sum_{i=1}^T (1 + Y_T^{FRM})^{-1}}$$

From the formulas the price level is inversely proportional to price level P_t . So, in the case of a fixed-rate mortgage that does not have a prepayment option or the possibility to refinance it, the contract could become risky since its value is sensitive to inflation. In fact, when inflation decreases, the interest rates go down. If the contract was an ARM, the monthly payments would have reduced in a proportional way following the market. However, in a FRM scenario the payments remain the same since they are constant and the houseowner cannot benefit of the fall of price level.

The interest rate for an FRM ($Y_{it}^{i,FRM}$) is not variable and is equal to the average interest rate calculated over the maturity of the loan plus a premium ($\alpha^{i,FRM}$) that compensates the mortgage lender for default risk:

$$Y_{it}^{i,FRM} = Y_{1t} + \alpha^{i,FRM}$$

The mortgage premium is more sensitive to the initial yield for FRMs compared to ARMs. This happens because fixed-rate mortgage contracts present the option to refinance; the higher the initial interest rates, the more probable that the borrower exercises the refinance option. Lenders compensate the risk that the refinancing occurs by applying a higher mortgage premium.

In this mode different situation of early termination of the contract are analyzed: refinancing, cash-out prepayment, termination due to random exogenous reasons. It is not described instead the scenario of institution of a second mortgage since this increases the number of variables and makes the analysis more difficult.

If there is a refinancing option the homeowner, after having subscribed the FRM and if the interest rates decrease, could decide to refinance the loan benefitting from the lower interests. The FRM made after refinancing has a principal equal to the remaining part of the old mortgage and a maturity of $T-t+1$ where t_{ref} indicates the period of refinancing.

Cash-out prepayment is interpreted as the situation where the household has enough positive equity and decides to repay the remaining debt. Exogenous random termination happens if borrowers in each period with probability φ_{it} must move and consequently they are required to sell the property and repay the outstanding part of mortgage.

The model presented the cash-flows $CF_{ijt}(S_t)$ that the lender receives in different scenarios. The cash-flows are calculated from household i on the type of the loan j , that could be either ARM or FRM, in the period t and in the state S_t . Moreover, the cash-flows depends on whether in period t prepayment or default happen. Campbell uses the indicator variables $D_{default\ ij t}^C$, $D_{prepay\ ij t}^C$ to indicate respectively default and prepayment result in period t by household i . If j is equal to FRM the indicator variable $D_{refinance\ ij t}^C$ indicates if there is a refinancing in period t .

The first case presented is that of no default nor repayment. The lender gets a nominal mortgage payment equal to:

$$CF_{ijt} = P_t M_{it}^j \text{ for } D_{default\ ij t}^C = D_{prepay\ ij t}^C = 0$$

where $D_{default\ ij t}^C$ and $D_{prepay\ ij t}^C$ are set to zero.

In a situation of default in period t $D_{default\ ij t}^C$ is set to one and the payment of the principal is stopped but the lender obtains the house. The cash-flow is given by:

$$CF_{ijt} = (1 - loss)P_t P_t^H H_i \text{ for } D_{default\ ij t}^C = 1$$

In the condition where there is an early termination due to a cash-out the outstanding principal is given to the lender and the indicator $D_{prepay\ ijt}^C$ is set to one:

$$CF_{ijt} = D_{it}^j \text{ for } D_{prepay\ ijt}^C = 1$$

Finally, if the type of the mortgage is an FRM and if the scenario of the refinancing occurs, $D_{refinance\ ijt}^C$ is set to one and the borrower has to pay to the lender the outstanding part of the loan plus the refinancing cost:

$$CF_{i,FRM,t} = D_{it}^{FRM} + c_r(1 - d_i)H_i \text{ for } D_{refinance\ ijt}^C = 1$$

The model can be used to calculate the cash-on-hand. For example, if there were no default nor early termination, before the last of the mortgage the cash-on-hand for an ARM will be equal to savings plus interest after tax, minus payment of the mortgage, minus maintenance expense and property taxes, plus labor income in the next period, plus tax on nominal interest and on property taxes:

$$X_{i,t+1}^j = (X_{it} - C_{it}) \frac{(1 + Y_{1t}(1 - \tau))}{1 + \partial_t} - M_{it}^i - (m_p + \tau_p)P_t^H H_i + L_{i,t+1}(1 - \tau) \\ + \frac{Y_{1t}^{ij} D_t \tau}{P_t} + \tau_p P_t^H H_i \tau$$

In the case of an FRM the equation is similar a part the fact that tax is calculated using the interest rate of the mortgage.

3 DEFAULT AND PREPAYMENT

3.1 DEFAULT

After the housing credit boom that took place in the first years of the 21st Century, in the late 2000s the mortgage default increased rapidly.

The housing boom develops worldwide between 1994 and 2006/7 and in particular in the first years of 2000s is caused by several factors. On one hand, the price of the houses grew up, the value on the market increased and this created a positive wealth effect. Consequently, also the money that people possessed became more valuable and they were more encouraged to use their equity to buy a property rather than to continue renting it a higher price. On the other hand, banks were fostered to lend mortgages since, due to the rise in the price of the properties, even if default occurred it could in any case sell the house at a higher price and make a positive profit. Then, people, guided also by interest of the government in housing sector and to the encouragement to homeownership, were over-confident and started to see housing as one of the best ways to invest money thinking that the interest rates would not increase. (Pettinger, 2018)

Between 2000 and 2006 the price of homes grew up by 55 percent and consequently renting become more expensive and was no longer an advantageous possibility (U.S. Census Bureau and U.S. Department of Housing and Urban, 2020).⁶ Moreover, as figure 3 shows interest rates collapsed passing from 6,5 percent to 1 percent between 2000 and 2003 and private banks could obtain cheaper loans from the central bank making higher profits by lending money. (Bakhtani, 2012). In this period lots of investors decided to enter in the market choosing to buy a property and hoping to make a profit from it. People take out mortgages to finance their acquisition 90 percent of which were adjustable rate characterized by low initial interest rates and then rescheduled after two or four years (Bakhtani, 2012). According to estimates, 20 percent of mortgages between 2005 and 2006 were opened to subprime borrowers that represent a high credit risk for lender since identify people with poor credit

⁶ Cited in Investopedia; "What is the housing bubble? Definition, causes and recent example" 2020, December 25

history including delinquent payments and normally would not have received a mortgage. (University, 2008)⁷

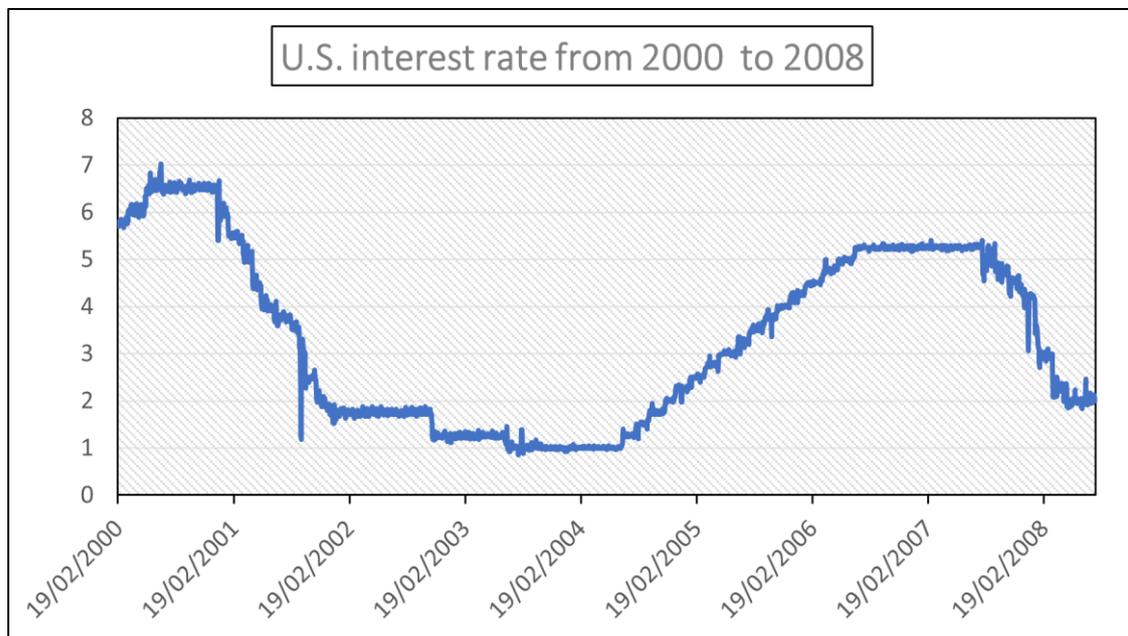


FIGURE 3: SHOWS INTEREST RATES IN U.S. FROM 2000 TO 2008. DATA SOURCE: MACROTRENDS⁸

As it is presented in figure 3 in 2006 interest rates rose from 1 percent to 5,25 percent in 2006, consequently ARM presented higher payments and subprime borrowers started to default since they are no longer able to make their payments. The housing bubble defined by “the Economist” as “the biggest bubble in history”⁹ exploded due to the fact that there were too many houses on the market. House prices started to decrease rapidly since the value of the property went down and after the peak reached in 2006, this resulted in a 19 percent price decrease between 2007 and 2009. (U.S. Census Bureau and U.S. Department of Housing and Urban, 2020)¹⁰ The crisis that started in U.S. rapidly affected global economy: with the higher interest rates the demand for goods and services decreased and firms slowed down production. As a

⁷ Cited in Investopedia; “What is the housing bubble? Definition, causes and recent example” 2020, December 25

⁸ The data are taken by the website www.macrotrends.net.

⁹ The Economist. June 16, 2005. “The worldwide rise in house prices is the biggest bubble in history. Prepare for the economic pain when it pops.”

¹⁰ Cited in Investopedia; “What is the housing bubble? Definition, causes and recent example” 2020, December 25

consequence, the demand for labor declined, GDP, that is a macroeconomic indicator used to measure the monetary value of goods and services produced, presented negative development in 2008 and unemployment grew up (Bakhtani, 2012). In this scenario for borrowers became very difficult to refinance their loans and default rates increased.

After starting a contract, a due date for the monthly payment is established. If the borrower is late by more than 30 days, the mortgage is considered to be in default. In this situation the bank can send a notice to a credit agency having an impact on the credit score¹¹. Subsequently the bank sends a notice also to the homeowner who have the chance to give the missing payments in full and avoid the risk of foreclosure. If he continues to be delinquent foreclosure starts and the property is taken over by the bank and sold at auction.

Moreover, people in some cases choose deliberately to walk away preferring the negative impact on their credit score. The borrower in each period has to face the decision whether to default and exercise the put option on the house or not. If delinquency occurs, the bank seizes the property, and the homeowner goes to the rental market.

Even if negative home equity, that occurs when the value of the property falls below the outstanding balance of the mortgage used, play an important role in the decision of default, it is not true that borrower with negative equity decide always to default¹²¹³. In fact, by exercising the option to default, the borrower refuses to use this possibility in the future and for this reason he has to consider also if it could be more profitable to continue making the mortgage payment and wait for the house prices growth. Homeowner should delay default if the interest on mortgage is lower

¹¹ A credit score is a number from 300 to 850 that is based on the past credit history and estimate the creditworthiness of an individual. Banks use this score to estimate the risk of lending money and the probability that a borrower will repay the mortgage. The higher the score, the better the image that the potential lender gives to the bank.

¹² In the paper "Why do borrowers default on mortgages?" Peter Ganong and Pascal J. Noel define as "strategic a default when negative equity is a necessary and sufficient condition and "cash-flow" when negative life event is a necessary and sufficient condition.

¹³ For further details see section 4.2

than the option of renting a house. (Elul, Souleles, Chomsisengphet, Glennon, & Hunt, 2010)

The level of negative home equity at which the homeowner default is not fixed but depends on liquid wealth and unemployment. A person that is unemployed and whose liquid wealth is not high usually is delinquent at a lower level of negative equity. (Schelkle, 2012)

Typically, delinquency happens in the first years of the mortgage due to the higher risks that characterized payments. Borrowers who choose to default are those with lowest house prices and lowest real income. The MTI ratio¹⁴ is an index used to measure mortgage affordability. It can be defined as:

$$MTI = \frac{M_{ijt}}{L_{it}}$$

where M_{ijt} is the mortgage payment and L_{it} is the level of labor income.

MTI is directly proportional to the probability of default and in particular mortgage payments-to-income is higher in the case of higher income risks and higher mortgage payments.

Both for ARMs and FRMs the larger the house price declines, the more probable delinquency to happen in fact, if the house price declines, this tends to be associated with a decrease in household's income. In this scenario people, when outstanding debt is large, are more likely to default since they are acquiring a property that is less valuable on the market than it was in the moment when they started the mortgage. In particular in the case of an FRM where the monthly rates are fixed, people continue paying the same amount of money even if the value of the property on the market went down.

Moreover, household that are owner of the house and live in the property are less inclined to default while investor that do not experience direct benefits from house services exercise the option more frequently. (Deng & Calhoun, 2002)

¹⁴ Usually, a good rule is that a maximum of 28 percent of the monthly gross income of a person could be spent on housing expenses.

Some remarkable information could be deduced from figure 4 that analyze information present in “A Model of Mortgage Default” by Campbell and Cocco, concerning default probabilities for FRMs and ARMs at different level of initial rate and income risk. Firstly, income risks and initial rate are directly proportional to default. In particular, if the initial rate increases, also the default probability arises and the same happens with lower income risk. Then, the reader can notice that in the scenario of high initial rate the default probability is higher for fixed-rate mortgages than for adjustable-rate ones, while in the case of low initial rate on the contrary the result is reversed. In the case of ARMs default is more common when the interest rates are higher and cause larger payments, while for FRMs lower interest yield causes lower cost of housing and a reduction of delinquency.

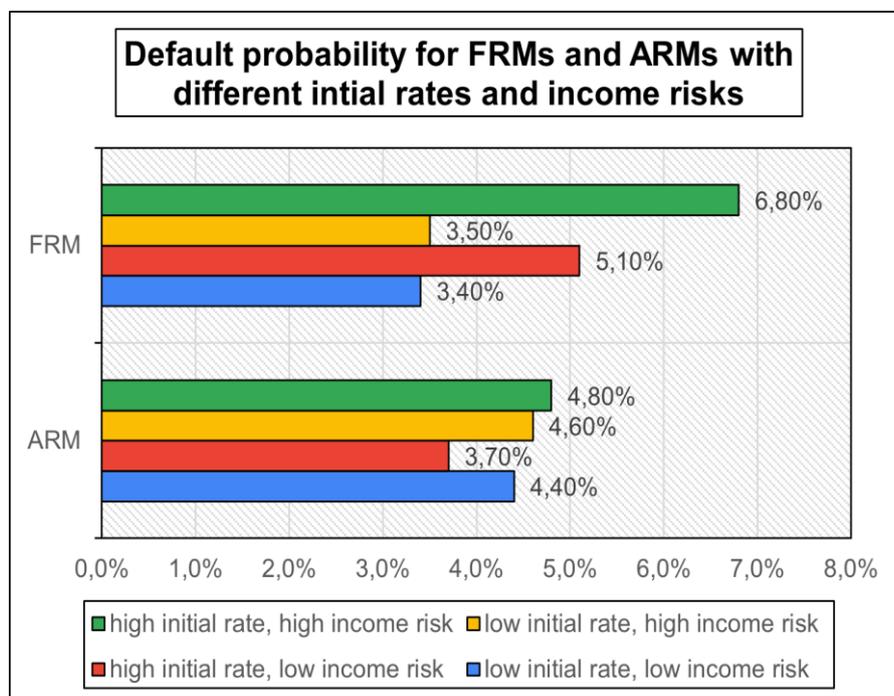


FIGURE 4: SHOWS THE DEFAULT PROBABILITIES FOR ARMS AND FRMs. SOURCE: CAMPBELL, J. Y., & COCCO, J. F. (2003). “HOUSEHOLD RISK MANAGEMENT AND OPTIMAL”. *QUARTERLY JOURNAL OF ECONOMICS*, 1449-1494

Consequently, the highest value could be found in the scenario characterized by higher income risk and higher initial rate where FRMs are 6,8 percent probable of defaulting. The income risk has a smaller impact on default rate while the initial rate is the factor that make the values change most. For what concerns ARMs the lowest

value is visible in the case of high initial rate and low-income risk while the other three situations do not differ in a considerable way.

Default rate depends also on loan size as it is explained in figure 5. Delinquency is lower for ARM than for FRM if the loan size is below 0,4 while the opposite is true for values of loan size between 0,5 and 1,25. For a loan that has size higher than 1,25 fixed-rate mortgages are more likely to default than adjustable-rate.¹⁵ (Deng & Calhoun, 2002)

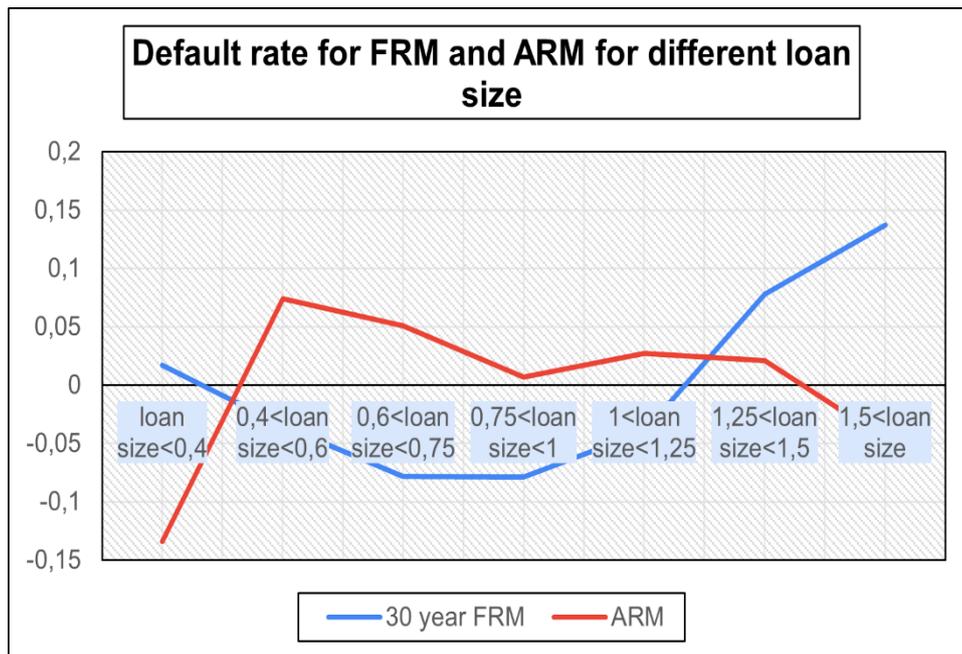


FIGURE 5: SHOWS HOW DEFAULT RATE FOR FRM AND ARM CHANGES RELATIVE TO LOAN SIZE. SOURCE: CAMPBELL, J. Y., & COCCO, J. F. (2014). "A MODEL OF MORTGAGE DEFAULT".

¹⁵ Data are obtained analyzing single-family residential mortgage. In the dataset studied by Calhoun and Deng around 630.000 adjustable-rate mortgages created between 1982 and 1993 and 650.000 fixed-rate loans between 1979 and 1993.

3.2. PREPAYMENT

If households accumulate enough positive home equity during years, they could decide to exercise the prepayment option by selling their property and repaying the outstanding part of mortgage in advance to what was scheduled.

Figure 6 shows that cash-out in the case of adjustable-rate mortgages is considerably higher than for fixed-rate. In the scenario of ARMs cash-out rate is higher if initial interest rate is higher while the opposite is true for FRMs. On one hand, cash-out rate is not influenced much by initial rate and the values remain around 60 percent. On the other hand, for FRMs the difference between values at low and high initial rate is approximately of 20 percent. Income risk is directly proportional to cash-out probability but doesn't affect results only in a small portion. (Campbell & Cocco, 2014)

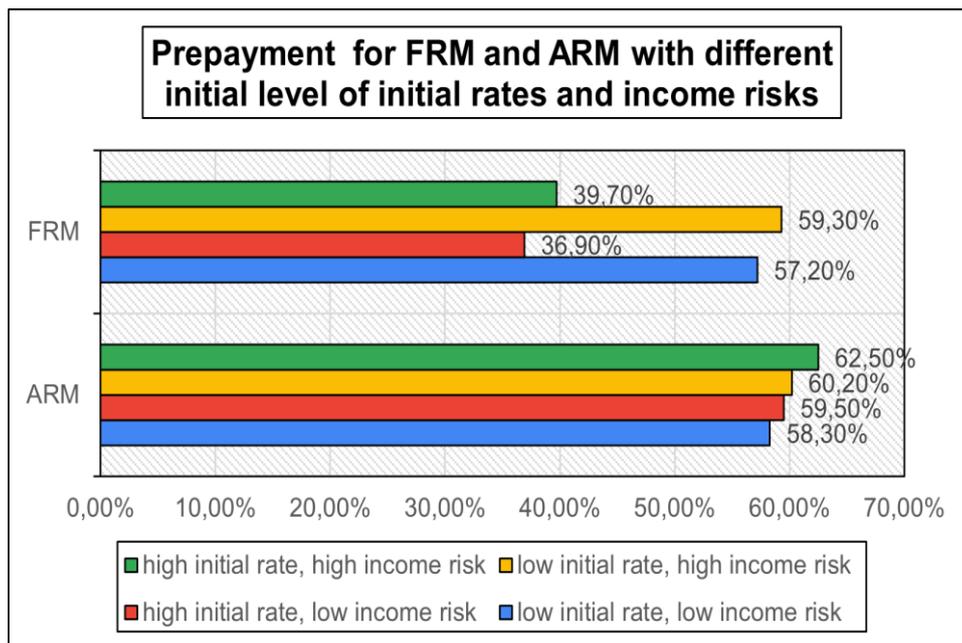


FIGURE 6: SHOWS PREPAYMENT FOR FRMS AND ARMS WITH DIFFERENT LEVEL OF INITIAL RATES AND INCOME RISKS. SOURCE: CAMPBELL, J. Y., & COCCO, J. F. (2003). "HOUSEHOLD RISK MANAGEMENT AND OPTIMAL". QUARTERLY JOURNAL OF ECONOMICS, 1449-1494

Prepayment decision is influenced by many factors that do not differ for fixed and adjustable-rate mortgages. Firstly, it is more probable if there is a higher level of

home equity that is caused by a larger increase in house prices and if the real income is lower. Then the mortgage-to-income payment influences cash-out in a proportional way and has a stronger impact if the initial rates are high. Loan size is directly proportional to cash-out rate and as long as it grows up, the option to prepay is more attractive both for ARMs and for FRMS.

Concerning FRMs, homeowners have also the alternative of refinance. It could be a profitable solution to benefit of a better interest rate and consequently the mortgage could result in reduced monthly payments or reduced terms. Moreover, this option could also be used to reduce the risk that the borrower faces by changing the contract from an adjustable-rate, where the payments vary according to the market movements of the interest rates, to a fixed-rate mortgage that is characterized by constant monthly payments. If initial interest rates are high and if they decrease, the probability of prepayment goes down because for a homeowner in this situation it is more convenient to refinance taking advantage of the lower yield that are applied to the mortgage.

3.3. LTI AND LTV

The loan-to-value ratio (LTV) is always defined as a percentage, and it is used to compare the amount of money that is borrowed to the price in the market of the asset that is bought. It is defined as follow:

$$LTV_{ijt} = \frac{D_{ijt}}{APV \text{ or } HP} * 100$$

where D_{ijt} is the amount of the loan principal outstanding at date t for borrower i on mortgage j and it is divided by APV (appraised property value) if the appraised value is below the purchase price or by HP (house price) if the contrary happens. (Green, 2022)

LTV could also be defined as $LTV = (1 - d_i)$ where d_i represents the down-payment that the borrower pays upfront.

It determines the amount of money that a borrower should employ in a down payment, (that is the difference between the property value and the loan amount). It measures also the level of risk to which the borrower is exposed when he writes a mortgage. (Hayes, 2022)

A mortgage is defined as “conforming” if the LTV is lower or equal to 80 percent and in general the higher the loan-to-value, the higher the interest rate and the probability of default. (Thornton & McDonald, 2008)

A value of LTV greater than one results in negative home equity that tends to happen if the house prices and at a moment where the mortgage outstanding is very high (generally early in life of the loan).

The loan-to-income (LTI) is a measure of mortgage affordability and is the ratio between the loan amount and the income of the borrower. It is calculated as follows:

$$LTI = \frac{(1 - d_i)H_i}{L_{i1}}$$

where L_{i1} is the level of labor income at the initial date and H_i is the value of the house considered.

Before the crisis and between 2002 and 2007 there was an increase in the average level of both LTV and LTI. Whereas the rising of loan-to-value was not very significant, the loan-to-income experienced a rapid growth: in 2002 it was approximately 50 percent and in 2006 it arrives to almost 80 percent. (Campbell & Cocco, 2014)

The effect of LTV and LTI index on default probabilities for FRMs and ARMs with low and high initial rate is studied in figure 7 that resume information Campbell and Cocco (Campbell & Cocco, 2014). The baseline situation is characterized by an LTV equal to 90 and a LTI that is 4,5. The loan-to-income appears to be directly proportional to default since when a lower LTI of 3,5 is considered, the default decreases. Due to the lower loan-to-income the mortgage payments become smaller and more affordable to sustain, constraints are less severe and for this reason people are less likely to default. In the third scenario the loan-to-value is decreased from 90 to 80, and this results in a large reduction of default rate caused by a decrease in negative home equity. Also, the opposite happens: the higher the LTV index, the higher the negative home equity and the probability to default; the higher the LTI index, the lower the affordability of the mortgage due to higher payments, the more binding the constraints and the higher default rate.

The fixed-rate mortgages present a lower default probability with low yield and a higher one with high yield while for adjustable-rate mortgages the opposite happens. The sensitivity of default rates to LTV and LTI is different: the impact of the former is stronger than that of the latter both in ARMs and in FRMs since the difference between the baseline situation and the one modified is respectively equal to 2,1 percent for ARMs and 2,1 percent for FRMs in the case of low initial yield and 1,9 percent for ARMs and 2,8 percent for FRMs in the case of high initial yield. Moreover, if the type is the FRM an increase in loan-to-income has a weaker effect on default rates than in the case of ARM.

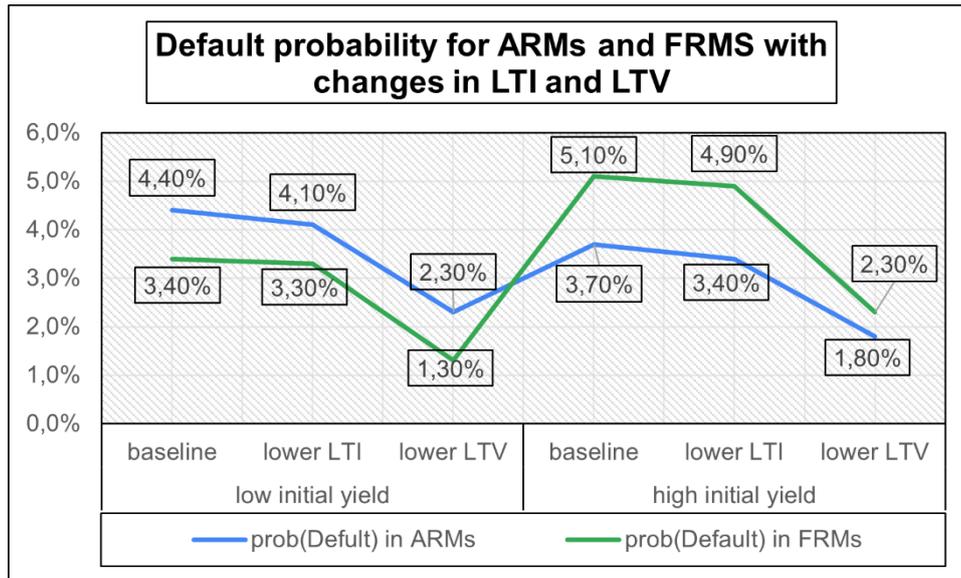


FIGURE 7: SHOWS DEFAULT RELATIVE TO CHANGES IN LTI AND LTV. SOURCE: CAMPBELL, J. Y., & COCCO, J. F. (2003). "HOUSEHOLD RISK MANAGEMENT AND OPTIMAL". *QUARTERLY JOURNAL OF ECONOMICS*, 1449-1494

Specifically, when LTV is lower than 70 borrowers aren't encouraged to default, whereas when it exceeds this value delinquency grows up both for ARMs and for FRMs becoming higher for adjustable-rate mortgages while reaching the maximum LTV.

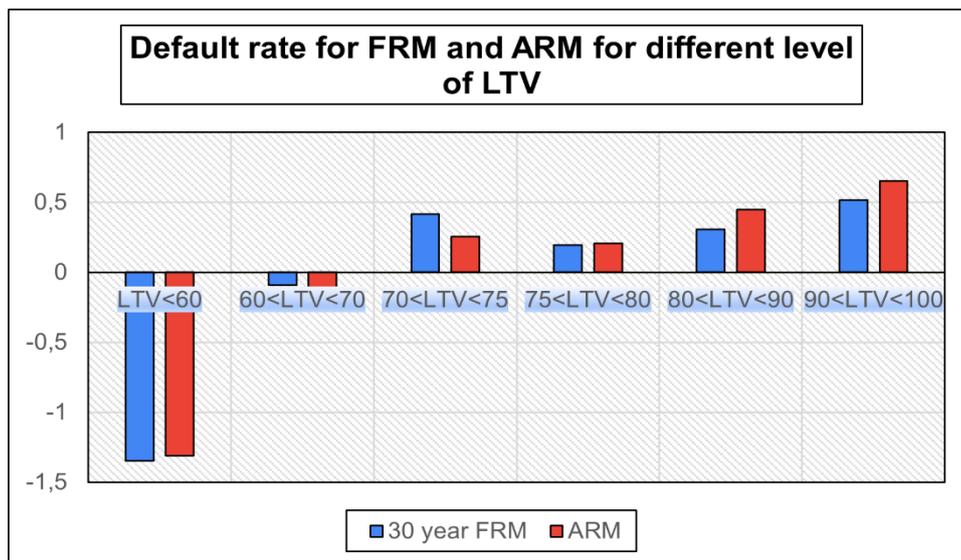


FIGURE 8: SHOWS THE RELATION BETWEEN DEFAULT RATE AND LTV FOR FRMs AND ARMs. SOURCE: CAMPBELL, J. Y., & COCCO, J. F. (2014). "A MODEL OF MORTGAGE DEFAULT".

Concerning prepayment, the impact of changes in loan-to-value is weaker than the effect for default and the higher probability of prepay can be found for loan-to-value lower than 60.

Differently from what is reported for default, loan-to-income is directly proportional to cash-out probabilities while loan-to-value is inversely proportional since a lower LTV result in a higher home equity. The baseline case highlights that the situation that presents the lower cash-out is that of fixed-rate mortgages at high initial yield (37 percent), whereas the other three situations display values around 60 percent. The effect obtained by lowering the LTI and the LTV is stronger in the case of high initial yield and for FRMs than for ARMs.

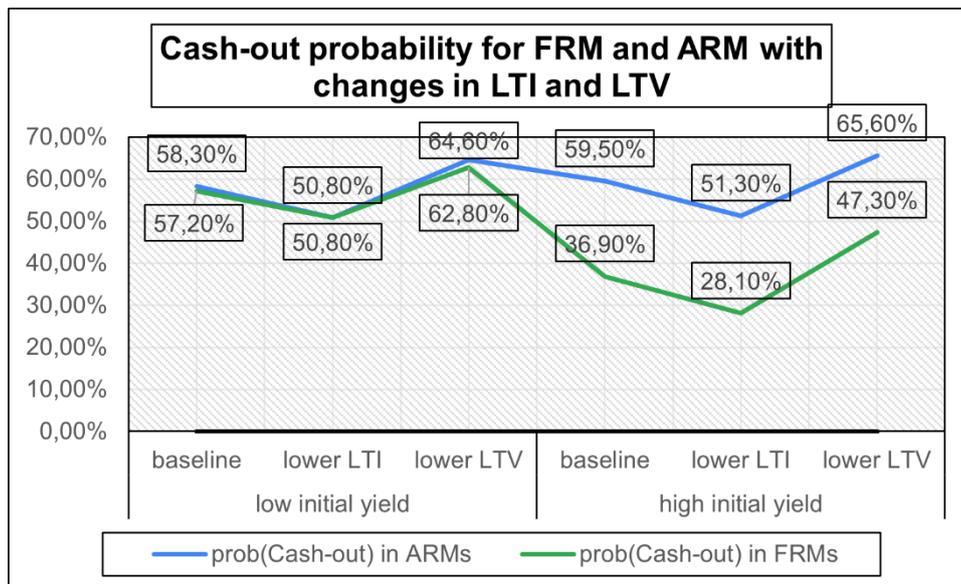


FIGURE 9: SHOWS CASH-OUT RELATIVE TO CHANGES IN LTI AND LTV. SOURCE: CAMPBELL, J. Y., & COCCO, J. F. (2003). "HOUSEHOLD RISK MANAGEMENT AND OPTIMAL". *QUARTERLY JOURNAL OF ECONOMICS*, 1449-1494

Concerning fixed-rate mortgages the reduction of loan-to-value provides a strong impact on the probability of refinance that decrease of a considerable amount. The option to refinance is considered only if the initial yield was higher and diminishes since in the opposite situation it would not create a profit. In the baseline case the refinance rate was 47,1 percent while by lowering the LTV from 90 to 80 there is a 28,9 percent probability of refinance. A reduction in LTI makes the refinance more probable with an increase of around 7 percent.

3.4. DEFAULT AND BANKRUPTCY

Decisions to default and declare bankruptcy results to be correlated in a strong way even if literature in most cases treated them as separate factors and influence between the two has been ignored. In fact, during years on one hand, default has been studied by lots of researchers that analyzed the role of liquidity in the process and found that this choice was taken when homeowners obtain a financial advantage from doing so. On the other hand, financial gain in bankruptcy has been explored examining also factors that influence this event.

Default happens when a debtor fails to meet his mortgage payment's obligations and is late. If the borrower continues to be late after a certain period of time that could differ across different mortgages, the lender will make a formal declaration of default.

Bankruptcy is a legal process that allows creditors to work with legal authorities to monitor finances of an entity that is insolvent and collect the outstanding obligations. Bankruptcy is managed by a court that decides how a debtor that is insolvent will operate with unpaid debts.

Concerning default, homeowners could declare it both because they are no longer able to pay the mortgage or because they do it strategically¹⁶. Households gain from default if the net present value of the cost of owning a house is larger than the net present value of the cost of renting. In other terms people are better off defaulting if $M_T - V > R_T$ where M_T represents the present value of mortgage payment from the moment considered until the final duration T , V is the value of the house and R_T is the discounted present value of the cost of renting from the present moment until duration T .

In general people are more willing to default if they have negative home equity and if they expect the home equity to rise in the future. After two or three months from the moment of delinquency, lenders start the procedure of foreclosure that presents different characteristics across different states in US. In some areas the lender is protected against the owner which is in default condition thanks to the "deficiency

¹⁶ See section 5.

judgement” that is a ruling applied when the sale of the house does not cover the full debt. In this situation the lender can collect extra money to cover the difference between the amount of the mortgage and the sale price. If deficiency judgement denoted DJ is allowed, homeowners gain from default if $M_T - V + DJ > R_T$. (Li & White, Residential Mortgage Default and Consumer Bankruptcy: Theory and Empirical Evidence, 2011)

Concerning bankruptcy, it could be attractive not only for homeowners who have positive home equity but also for those that present negative one. In the first case declaring bankruptcy people foreclosure can be hold up and deficiency judgement can be discharged while in the second scenario they are allowed to continue living in the house. Moreover, owners who default are incentivized to file for bankruptcy since they have lower costs due to the reduction in their credit score.

U.S. provides two different alternatives called Chapter 7 and Chapter 13.

The first procedure could be useful for homeowners that are in financial distress and want to keep their property: in fact, unsecured debt is discharged, and this helps creating additional assets to repay the mortgage. Moreover Chapter 7 results favorable also for people that are not interested in saving their house but want to use bankruptcy to delay foreclosure and try to sell privately the property at a higher price by making positive profit.

Chapter 13 is a procedure for homeowners that are in financial distress and want to save their house even if they do not have enough equity. It proposes a court-supervised repayment plan to repay the mortgage over five years. The original mortgage could be reinstated if homeowners succeed in repay arrears and keep their normal payment.

In 2005 some changes are introduced thanks to bankruptcy reform. Firstly, a “mean test” that obliges some houseowner to declare bankruptcy under Chapter 13 is introduced. If people have an income that results to be below the median of the state, they can still choose which procedure to use but if their income is above the median, they are required to operate with Chapter 13 and use the difference between their income and the median level to pay off the debt. Secondly, the mortgage crisis

affected costs for filing for bankruptcy lowering them and making both Chapter 7 and Chapter 13 less attractive. Finally, home values are reduced and consequently the cost of owning grew up while the renting cost remain unaffected. For this reason, homeowners are encouraged to declare default since they no longer receive an advantage in owning a house. (Li & White, Mortgage default, foreclosure and bankruptcy, 2009)

Li and White in 2011 in the working paper “Residential Mortgage Default and Consumer Bankruptcy: Theory and Empirical Evidence” analyzes a sample of approximately 250.000 fixed-rate¹⁷ mortgage to examine the decisions of default and bankruptcy and the correlation between the two. They define default when the mortgage results to be delinquent for at least 90 days¹⁸.

Li and White predict in each quarter the probability of default and bankruptcy where the former grows up when the home value is lower, and the latter is inversely proportional to income. They found that householders are more inclined to default and file if there is a forecasted financial gain from doing it and conversely, they are less likely to default if the model forecast an advantage from bankruptcy and vice versa. In addition, the predicted values both for default and for bankruptcy are higher than the real ones: this happens because many borrowers do not act when they would gain a financial advantage from doing so.

They showed that the default rate remained almost constant during the period considered while concerning the bankruptcy filing rate there was an upward trend until the 2004 and in 2005 it dropped due to the bankruptcy reform. They considered also the timing of bankruptcy decision relative to default and found that householders tend to declare bankruptcy after default rather than before. In fact, defaulting is related to a considerable rise in bankruptcy probability in particular in the first year. (Li & White, Residential Mortgage Default and Consumer Bankruptcy: Theory and Empirical Evidence, 2011)

¹⁷ They decided to fixed-rate mortgage since adjustable-rate are more difficult to analyze since the interest rate, after being fixed for a certain period, become variable following the market trend.

¹⁸ The timeslot of 90 days is chosen because they want that default variable identifies homeowners that are intended to leave their house and not those who repay arrears.

4. COMPLEX MORTGAGES

As the previous part expose, the most employed types of mortgages are the FRMs that maintain the interest rate fixed during the whole duration and the ARMs where the interest rate is variable and follow the market.

However, in the early 2000s the market changed, and a new type of mortgage called “complex” acquired importance and thanks to the emergence of substitutes, in the United States homeownership rate grew up from 63,9 percent in 1992 to 69 percent in 2004 and mortgages increased from 38,4 percent to 45,4 percent during the same period. (Bergstresser & Beshears, 2010). The increase in the utilization of complex mortgage is a phenomenon that diffuse non only in the US but worldwide: for example, in 2003 in Denmark, Interest-Only¹⁹ mortgage constituted approximately 50 percent of the outstanding mortgage debt. (Bäckman, Claes, & Khorunzhina, 2020)

Different forms of complex mortgages can be identified. The majority of CMs are adjustable-rate contracts where the time of the payments is variable, and amortization is limited in the initial years of the contract.

Complex mortgages present lower payments during the first years of the contract compared to fixed-rate and adjustable mortgages and they are used to finance more expensive houses that need a larger loan amount.

Amronin and Huang in their research considers three distinct categories of complex mortgages: Interest Only (IO), Negative Amortization Mortgage (NEGAM) and Teaser Rate Mortgage (TRM).

Interest Only mortgage is a contract in which the borrower is required to pay only for a limited period that usually is between five and ten years the interest of the loan. After, the loan follows a fully amortized scheme and the payments that the borrower give rise so that they can repay both the interest and the principal.

IOs are advantageous for borrowers that expect their income to grow up since they limit the amount of payment required and large payments are asked in the future.

¹⁹ See page 33.

However, in the introductory period the homeowner does not collect part of the equity since he is paying only interest. In this way when he starts to compensate the principal, the amount grows up rapidly and the borrowers should have carefully estimated their future cash flow so to be able to pay the rate given. (Kagan, Interest-Only Mortgage: Definition, How They Work, Pros and Cons, 2022)

Negative Amortization Mortgage presents a particular payment scheme. In fact, the borrower has the option to pay an amount that is less than the interest charged. In this way deferred interest that is the difference between the interest and the payment of the mortgage is generated.

NEGAM could be an appropriate solution for people that think that their income is going to grow up since at the beginning the amount to give is lower. The main risk of Negative Amortization Mortgage is that the principal owed increases and the payments will become larger when the mortgage become a fully amortizing loan. In some contracts there could be a negative amortization limit that is used to set the maximum amount so that if it is reached the payment is recalculated (Kenton, 2022).

Finally, Teaser Rate Mortgage is a contract where the initial interest rate is below the indexed rate. The fact to have a lower interest rate for a fixed amount of time could be an incentive for purchasing and increase the number of customers. Borrowers that use TRMs have to be aware of the rate that will increase significantly when the teaser rate expires. The majority of teaser rate also presents negative amortization. (Kagan, Teaser Loan, 2022)

Figure 10 presents the distribution of adjustable-rate, fixed-rate and complex mortgage in the period between 1995 and 2009 analyzing the data reported in the paper “Complex Mortgages” written by Amronin and Huang in 2010, taken by LPS Applied Analytics. FRMs are the most employed contracts all over the period analyzed. From 1995 to 2003 the market is dominated by FRMs that are used in more than 80 percent of cases and in 1999 and 2001 monopolize almost fully the market seizing more than 95 percent. In that period the remaining part of the mortgage is filled by ARMs while the percentage of CMs is negligible. In 2005 then ARMs represent only 10 percent of cases while the percentage of CMs grows up reaching about 30 percent in the second half of 2005. In years between 2005 and

2009 the percentage of both ARMs and CMs declines rapidly touching almost 0 percent in 2009 when the market results again monopolized by FRMs. (Amromin & Huang, 2010)

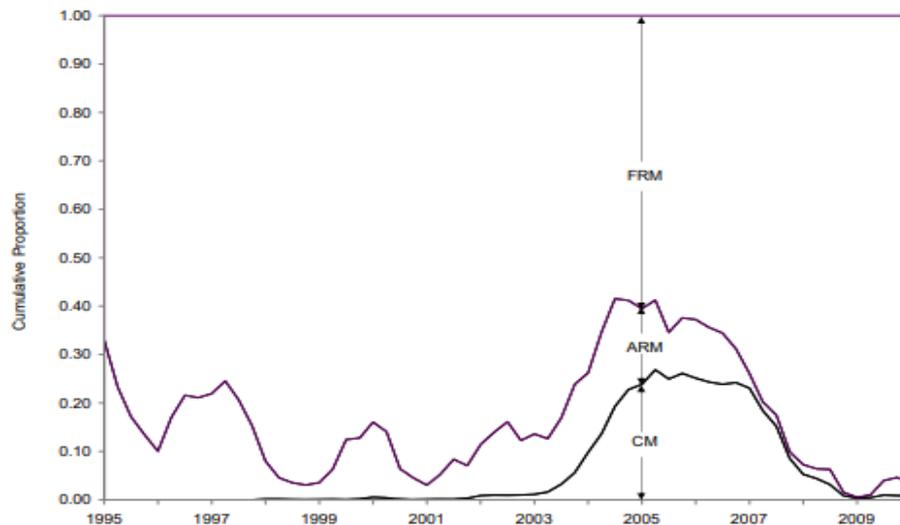


FIGURE 10: SHOWS THE PROPORTION OF FRMs, ARMs AND CMs FROM 1995 TO 2009. **SOURCE:** AMROMIN, G., & HUANG, J. (2010, NOVEMBER 24). “COMPLEX MORTGAGES”. *FEDERAL RESERVE BANK OF CHICAGO.*

The database employed by Amromin and Huang in their study contains information on 10 million loan contracts created between 2003 and 2007. Among them around 69 percent are constituted by fixed rate mortgages (FRM), 12 percent are adjustable-rate mortgages (ARM) and the complex mortgages (CM) represent the remaining part counting around 19 percent of cases. (Amromin & Huang, 2010)

Amromin and Huang analyze the monthly payment of ARMs and CMs relative to FRMs with similar characteristics and they found that approximately 64,5 percent of ARMs and 85,5 percent of CMs display a payment ratio lower than those of an FRM in the first year of the contract. Moreover, almost 50 percent of complex mortgages result to be 20 percent lower than fixed ones (Amromin & Huang, 2010). This is due to the fact that initial interest rate results lower for ARMs and in particular for CMs relative to FRMs.

Complex mortgages are contracts where reduced payment are followed by higher one that need also to repay the principal; for this reason they are chosen on one hand by

borrowers who know that their income are going to grow up due to local economic condition or to their working position and that they can face the increased rate in the future and on the other hand by people who expect house prices to increase in the future so that their investment could be profitable.

Figure 11 analyses income, house value and loan amount comparing the data for CMS, ARMs and FRMs. On average complex mortgages are used by people that hold a higher income. As a consequence, they are employed to finance houses that are more expensive boasting a higher market value and to do that the loan amount to pay increase relative to FRMs and ARMs. For instance, the reader can see that the average house value for FRMs is the lowest and accounts only for \$264.878, the average value for ARMs increases and is equal to \$309.465 while the one for CMs is the highest one and is \$513.728. For what concerns the loan amount the average value for complex loan is \$357.887 that approximately twice the amount for fixed rate mortgage that is \$179.415 while the value for fixed rate mortgage is equal to \$220.374.

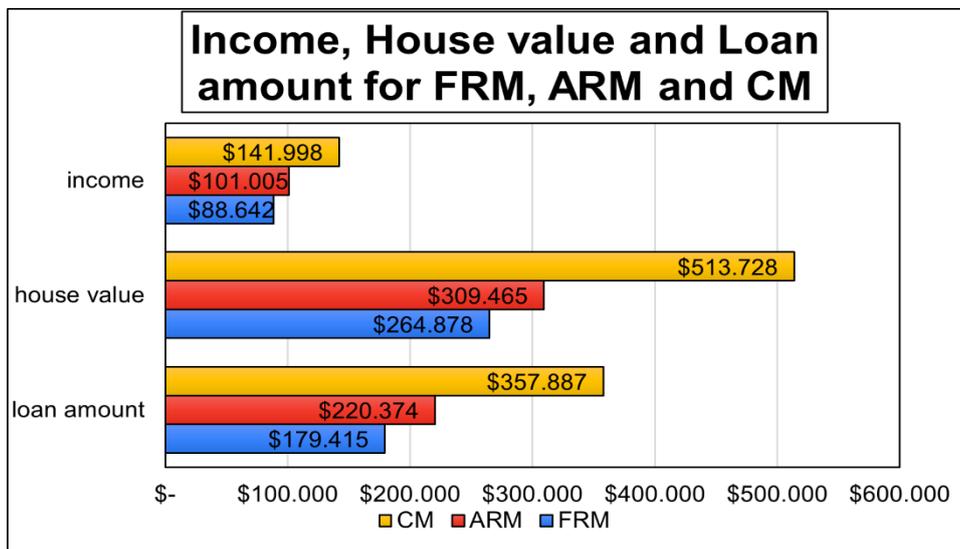


FIGURE 11: SHOWS THE INCOME, THE HOUSE VALUE AND THE LOAN AMOUNT FOR FRMS, ARMS AND CMS. SOURCE: AMROMIN, G., & HUANG, J. (2010, NOVEMBER 24). "COMPLEX MORTGAGES". FEDERAL RESERVE BANK OF CHICAGO.

Figure 12 presents the VTI (Value to Income) that is the average ratio of house value relative to income for the three types of mortgages. Complex mortgage borrowers

result to live in areas with a higher proportion of graduates, have on average a higher income and on average display a lower unemployment rate. Moreover, they use mortgage to finance houses that are more expensive relative to income compared to the other alternatives. In effect, CMs present an average VTI of 4,07 while the values for ARMs and FRMs are respectively equal to 3,46 and 3,4.

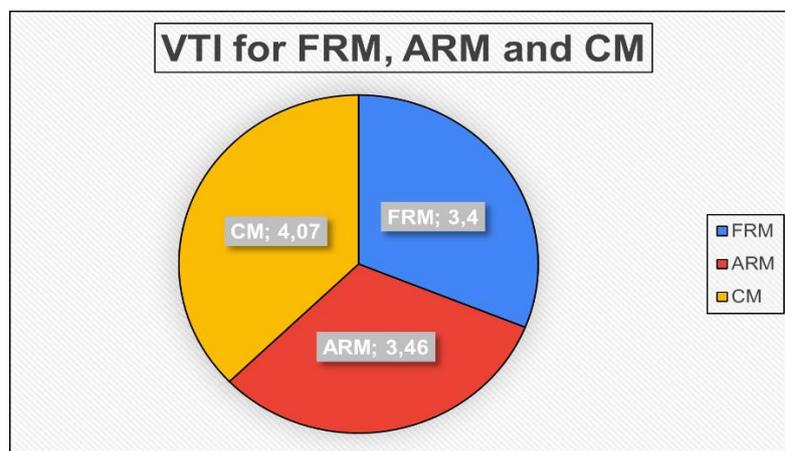


FIGURE 12: SHOWS VTI FOR ARMs, FRMs AND CMs. SOURCE: AMROMIN, G., & HUANG, J. (2010, NOVEMBER 24). "COMPLEX MORTGAGES". FEDERAL RESERVE BANK OF CHICAGO.

Amronin and Huang analyses then in a more detailed way complex mortgages dividing them between Interest-Only (IO), Negative Amortization (NEGAM) and Treasure Rate Mortgage (TRM). (Amromin & Huang, 2010)

TRMs are preferred in general by people that have a higher income. Consequently, Treasure Rate Mortgages have a higher loan amount and are used to finance more expensive houses. Also, the Value to Income is higher for CMs and reflect the fact that people that use this type of contract have on average a higher disposal of money. TRMs result to be advantageous mortgage since at the beginning present the lowest initial interest rate while for Ios and NEGAMs the yield is approximately six time higher.

4.2. DELINQUENCY, BANKRUPTCY AND PREPAYMENT

4.2.1 DELINQUENCY

Amronin and Huang in their research study the delinquency, the possibility of bankruptcy and the prepayment analyzing almost ten million mortgages in the period between 2003 and 2007. The database is composed by 69 percent of fixed-rate mortgages, 12 percent of adjustable-rate mortgages and 19 percent of complex mortgages (with respectively 6.895.047, 1.174.328 and 1.917.719 observations).

A mortgage is considered to be delinquent if there are at least 60 days of delay by the borrower in the payment. Delinquency ratios are very different in the three scenarios analyzed. CMs, as the document previously explained, present a payment that is low since it is not fully amortized and increase during the life of the contract. For this reason, generally the delinquency rate in the initial period is lower and then it grows up. Another important consideration is that ARMs and CMs have interest rates that are variables following the fluctuations of the market and in these scenarios, it is very difficult to predict the long-term interest rate. In a rising interest rate environment delinquency could be higher for ARMs and CMs because of the growth of mortgage payments. Moreover, the mortgage balance is paid at a slower rate by CMs compared to FRMs and ARMs. In particular, Amronin and Huang shows that even five years after origination approximately 51 percent of CMs are within 2,5 percent of their balance. Consequently, borrowers of complex mortgages are more likely to default for strategic reasons and in situation of financial difficulties could decide to walk away from the contracts.

Figure 13 shows the proportion of mortgages that are at least 60 days delinquent. FRMs present the lowest rate of delinquency. Complex mortgages have a ratio that is lower than adjustable rate in the first year, but then in the following years become the contract with the highest probability of delinquency. The reader can also notice that the gap between ratio delinquency of FRMs and CMs increases over the years. In particular, in year one it is 1,37 percent, in year three it is equal to 8,25 percent and in year five to 10,8 percent (with observations of respectively 2,65 percent for FRMs and 4,02 percent for CMs in year one, 9,31 percent in the case of FRMs and 17,56

percent in the case of CMs in year three, 11,95 percent for FRMs and 22,75 percent for CMs in year five).

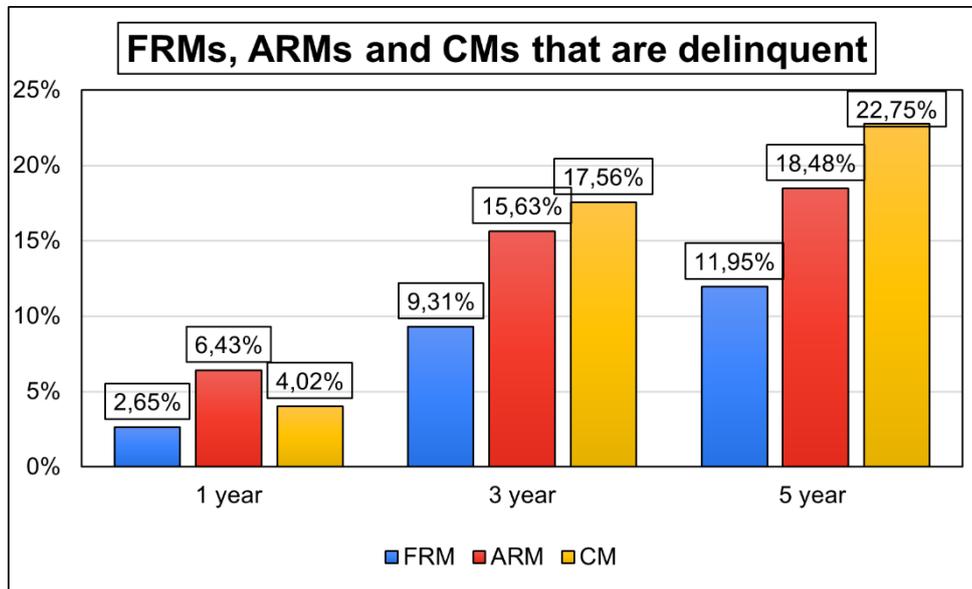


FIGURE 13: SHOWS DELINQUENCY FOR FRMS, ARMS AND CMS. SOURCE: AMROMIN, G., & HUANG, J. (2010, NOVEMBER 24). "COMPLEX MORTGAGES". FEDERAL RESERVE BANK OF CHICAGO

Amronin and Huang analyzing the distribution of mortgage delinquency, found that there are peaks of 1,3 percent and 1,2 percent of delinquent loans after 27 and 39 months from originations. LTV, that is calculated dividing the loan amount at the end of the prior period by the loan value, is directly proportional to delinquency.

In general, complex mortgages are chosen by borrower who are more inclined to risk and to strategic default. Delinquency is influenced by the income level: the higher it is at origination, the lower the default ratio particularly for subprime borrowers that have higher risks. Then people that live in areas that experience a higher unemployment rate are more likely to default since it could be more difficult to make the payments.

4.2.2. BANKRUPTCY

Even if the concept of bankruptcy is strictly related to that of default, households that declare bankruptcy not necessarily default nor it is true that those who default are

also declaring bankruptcy²⁰. In the database proposed in the text analyzed, 29 percent of borrowers that declare bankruptcy also default and 13 percent of those who are delinquent also result in bankruptcy.²¹

The proportion of mortgages that face bankruptcy for FRMs, ARMs and CMs is presented in figure 14. In the first year the percentage of bankruptcy is very low and there isn't a notable difference between the three scenarios. In the following years the ratios increase for all the type of contracts and the gap between fixed rate and the other two mortgages become bigger. FRMs present the lower probability of bankruptcy that is equal to 1,51 percent after three years and 2,15 percent after five years.

In general default is more common than bankruptcy and, in some cases, owners prefer to walk away from the property when it is economically advantageous to do so even if they have enough money to continue the payment.

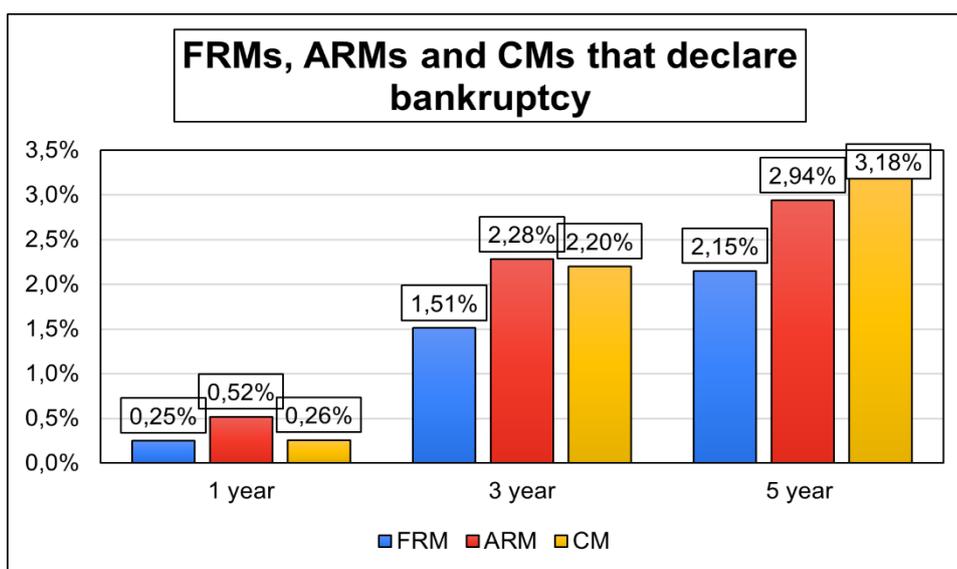


FIGURE 14: SHOWS BANKRUPTCY FOR FRMs, ARMs AND CMs. SOURCE: AMROMIN, G., & HUANG, J. (2010, NOVEMBER 24). "COMPLEX MORTGAGES". FEDERAL RESERVE BANK OF CHICAGO

²⁰ For further details see section 3.4 where the relationship between bankruptcy and default is investigated.

²¹ In the paper "Did bankruptcy reform cause mortgage default to rise?" Wenli Li, Michelle J. White and Ning Zhu examine the relationship between bankruptcy and mortgage default.

4.2.3. PREPAYMENT

Prepayment occurs when borrowers decide to extinguish their mortgage before maturity. They can do this in two different ways: by paying the remaining part selling the house or by refinancing it.

Figure 15 shows the proportion of mortgages that are prepaid. The percentages increase over time. FRMs report the lowest values followed by CMs and by ARMs that have the highest probability to be prepaid. In particular after one-year FRMs are 7,66 percent while CMs are 12,05 percent and ARMs 15,10 percent probable to declare bankruptcy. After five years the proportions increase to 37,29 percent for fixed rate, 45,34 percent for complex and even 59,98 percent for adjustable-rate mortgages.

Variables that decrease the probability of delinquency, increase also the probability of prepayment. For instance, LTV that increase the probability of default, is inversely proportional to prepayment.

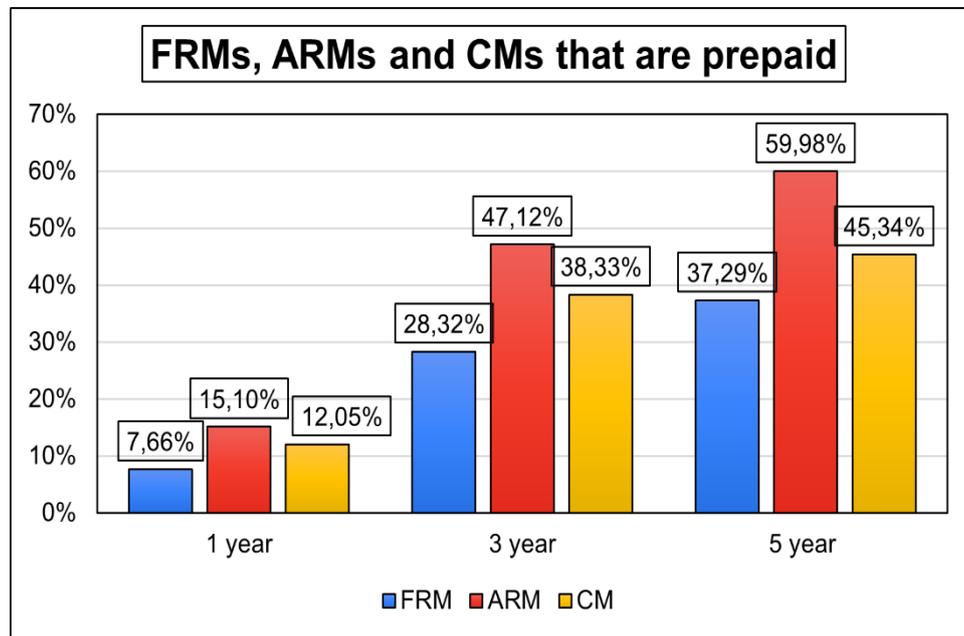


FIGURE 15: SHOWS PREPAYMENT FOR FRMs, ARMs AND CMs. SOURCE: AMROMIN, G., & HUANG, J. (2010, NOVEMBER 24). "COMPLEX MORTGAGES". FEDERAL RESERVE BANK OF CHICAGO.

5. STRATEGIC DEFAULT

After the Great Depression, the interest in delinquency grew up and in the second quarter of 2010 Google searches for “strategic default” peaked. (Ganong & Noel, 2020)

Strategic default could be defined as a deliberate decision of stop making the payments on a debt and is a condition difficult to study since it is unobservable. By considering in a simplified way strategic default as the ratio between number of strategic defaulters and the number of defaulters that a person knows, in March 2009 approximately 26,4 percent of defaults appear to be strategic, and the percentage grew up in September 2010 to 35,1 percent. (Guiso, Sapienza, & Zingales, 2011)

During the second half of 2000s, millions of households had mortgages that go beyond the value of the house and according to First American CoreLogic in 2009 it is estimated that the percentage of homes with negative home equity was 23 percent, and, in some areas, it exceeds 50.²²

Negative home equity is a necessary condition in the choice of defaulting, but it is wrong to assume that homeowner always decide to default when they face this condition. In fact, other economic factors influence this decision: being delinquent involve relocation costs that have to be sustained and, in some cases, people face the risk to lose other assets whether the mortgage is a recourse-loan and there is a deficiency judgement proposed by the lender that force owners to pay the remaining amount of the loan. Moreover, the credit rating of the homeowner could be ruined by defaulting and this have negative impact on the future capability of renting. (Kagan, Strategic Default, 2022)

Then, since walking away is irreversible, households in each period should analyze the costs and benefits and investigate if it is a better financial decision to postpone the option and continue making the payments. When the option of renting become lower than the interest on mortgage strategic default is a way to cut losses.

²² Cited in the article “Housing units with negative home equity” by George R. Carter reported in “Cityscape: A Journal of Policy Development and Research of 2021 volume 14.

Houseowners have to compare the decision of walking away today to that of doing it in the future taking into account also the economical availability and if they will lose their job. Waiting could be more advantageous if the price of the houses is volatile and there are higher expectations that they will increase in the future.

Considering a borrower who owns a house of value H and face a payment M . From a financial point of view, it is not profitable to default if $H > M$ but to consider strategic default other determinants than pure gain and loss have an impact. K is defined as the net benefit of non-defaulting that include for instance, the possibility to live in the property. It is a better choice to not default if:

$$H - M + K > 0$$

The option of strategic default is influenced by the size of the shortfall ($H - M$), the the option value of non-defaulting and the pecuniary and not-pecuniary costs of defaulting.

$$\text{Strategic default} = f(H - M, h, rm, K, \pi_t)$$

where rm is the mortgage payment and π_t is the probability of borrower to become unemployed and h refers to the monetary value of housing services. (Guiso, Sapienza, & Zingales, 2011)

Concerning pecuniary relocation costs, the difficulties in buying or renting a new property, due also to the downfall in the individual's credit score, are included. The amount of relocation costs is not fixed but is influenced by some determinants such as the number of children that produce higher costs and the age of the individuals where for older people relocating is more expensive. Moreover, most people buy a house that adapt specifically to their needs and for this reason they assign a higher value to their property compared to a similar one. The attachment to the house is an important factor to consider that makes people less likely to relocate in fact, the more years passed from the moment when people bought a house, the more they are attached to it and the higher the relocation costs.

The willingness to default is not only affected by socio-economic factors but also by non-pecuniary characteristics. For instance, walking away could be considered

morally wrong and for this reason could be avoided even if there is a large equity shortfall since people take into consideration also the social cost of defaulting and are influenced by the public opinion. On the other side being amoral is not a necessary condition to default in fact, even people that consider it morally acceptable, could prefer not to do it if the costs that are involved in the decision are too high.

Moreover, background of homeowners and social contagion are determinants of strategic default in the way that people who know someone who exercised this option are more likely to do the same.

Morality acquires an important role in decision of default. The data derived from the work of Luigi Guiso, Paola Sapienza and Luigi Zingales that collected information on a representative sample of 1000 American households, contained in "Moral and Social Constraints to Strategic Default on Mortgages" of 2009 are presented in figure 16 that analyze different levels of negative equity. On one hand, the percentage of people that are likely to walk away increases if this decision is not considered immoral. On the other hand, the higher the negative equity, the higher the willingness to delinquency. In particular, if negative equity is \$50 thousands 7 percent of "moral"²³ people are likely to default versus 20 percent of "immoral"²⁴ ones and this gap become larger when negative equity grows (at -\$100 thousand respectively 22 percent of people that considered default morally wrong and 41 percent of those that consider it not wrong are likely to be delinquent.

In this article homeowners are submitted to a survey to understand which factors determine their moral view. Both people that are less than 35 years old and people that are more than 65 in a stronger way, appears to be less likely to think that default is morally wrong. Moreover, more educated respondents result "moral" and people who know someone who defaulted are more willing to consider it a good move.

²³ People are considered "moral" if they think that default is morally wrong.

²⁴ People are considered "immoral" if they think that default is not morally wrong.

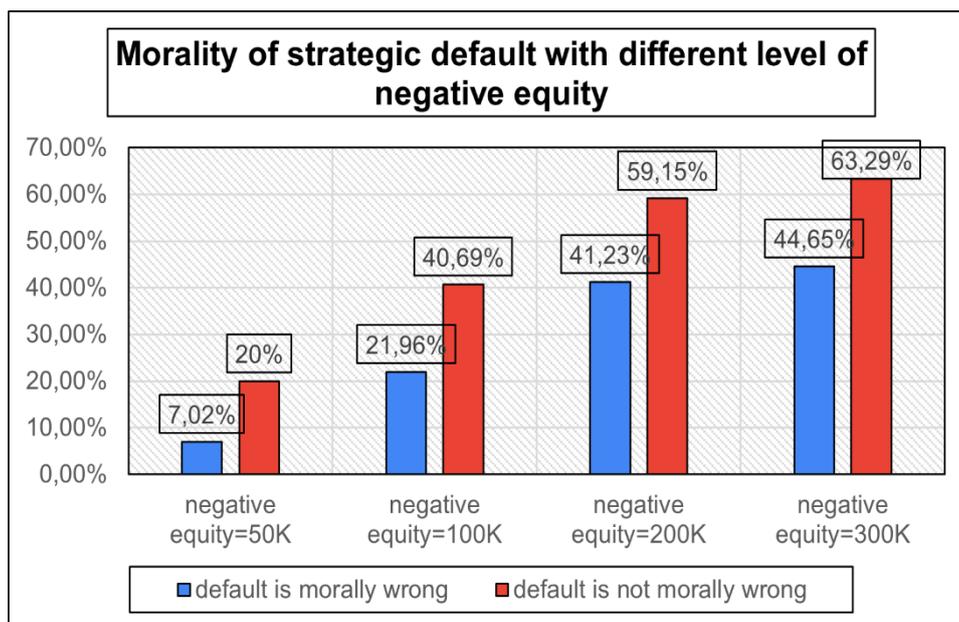


FIGURE 16: SHOWS MORALITY OF DEFAULT FOR DIFFERENT LEVELS OF NEGATIVE EQUITY. SOURCE: GUISO, L., SAPIENZA, P., & ZINGALES, L. (2011). "THE DETERMINANTS OF ATTITUDES TOWARDS STRATEGIC".

Concerning determinants of strategic default, a factor that have a strong influence is shortfall whose effect is reported in figure 17 holding wealth arising from the house constant. By increasing shortfall of \$50 thousands, the percentage of households who walk away rise of 14 percent (for a shortfall that starts at 0), by 21 percent (starting at \$50 thousands) and 17 percent moving from \$100 thousand s to \$150 thousands. Moreover, the higher the house value, the lower the willingness to be delinquent.

$U(W_i - S)$ denote the utility for a houseowner that decide not to default where W_i is the initial asset and S the home equity shortfall. The utility becomes $U(W_i - C_i)$ in the case of defaulting where C_i represents the monetary cost of this action. A person defaults if $S > C_i$ and the hypothesis that the cost of default and the value of the house are independent is rejected since the fraction of defaulters is not constant with the same amount of shortfall. Cost of default results also not to be proportional to the value of the house. If this would be true relative shortfall could be written as $s_i = \frac{S}{W_i}$ but doubling relative shortfall by doubling S or by dividing by two W , doesn't have the same results. For instance, comparing the percentage of people that are likely to

default when shortfall is \$100 thousands and house value is \$200-400 thousand to that relative to \$100-200 thousand value, even if the relative shortfall should have been doubled, the percentage of households that want to default pass from 19 percent to 27,8 percent. Maintaining house value fixed and lower than \$100 thousands, doubling the shortfall from \$50 thousands to \$100 thousands does not imply the doubling of defaulters but the results move from 14,4 percent to 35,9 percent. At the end, doubling the relative shortfall through an increase of shortfall has a stronger impact and the probability of default is more influenced by this change rather than by house value. (Guiso, Sapienza, & Zingales, 2011)

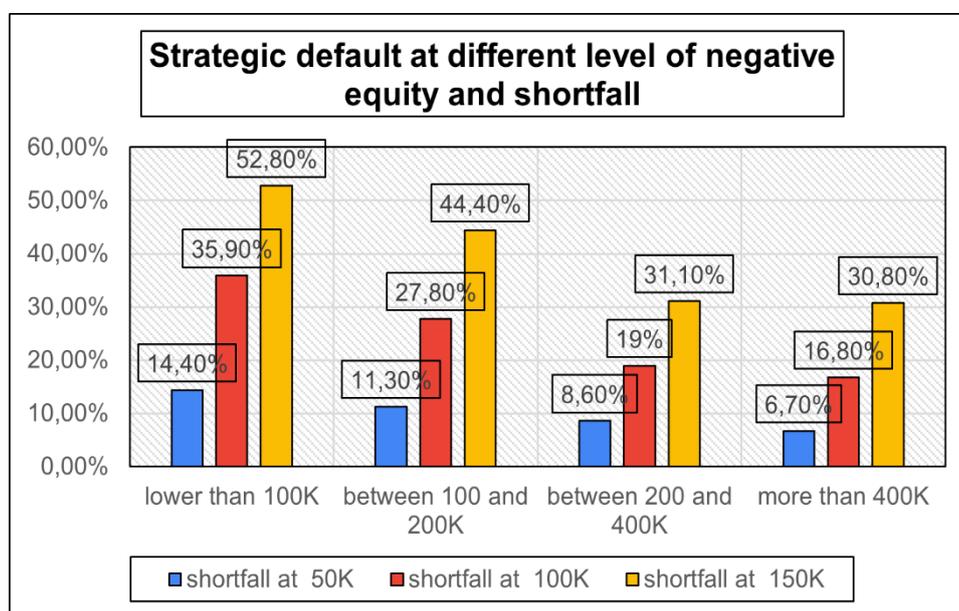


FIGURE 17: SHOWS STRATEGIC DEFAULT AT DIFFERENT LEVEL OF NEGATIVE EQUITY AND SHORTFALL. SOURCE: GUISO, L., SAPIENZA, P., & ZINGALES, L. (2011). "THE DETERMINANTS OF ATTITUDES TOWARDS STRATEGIC".

Another notable contributor of strategic default is emotional attachment that affects it in a negative way. This factor is analyzed asking to respondents if they bought the house more than five years ago and people that asked affirmatively results to be less likely to default since they have a stronger and longer link with the property. In the same situation if the negative equity increases, the attachment has a lower impact, and the economic reasons prevail.

Expectations about the future also impact the decision to walk away: in particular, if people forecast to lose their job in the following years, the probability of default will

increase, and it will become even higher in a scenario characterized by a higher negative equity. Then, if the house prices are expected to grow up, homeowners will be less likely to default and will take advantage of the value that the waiting option could give them.

Finally, people that defined them as more risk-averse will be less inclined to walk away and the percentage do not change considerably with the increasing of negative equity.

In 2016 Tajaddini and Gholipour in the article “National Cultural Default on Mortgages” analyzes for the first time the relationship between cultural characteristics and mortgage default. They follow the studies of Hofstede that in 2010 identifies six different aspects that describe a person’s cultural profile and try to understand how they influence delinquency.

The first one is individual versus collectivism (IDV) that shows the interdependence between satisfying individual needs and interacting with the other members of society and is positively correlated with default. People in high IDV societies have higher tendency to default since they tend to be too optimists about their future income and invest in higher properties. People that live in low IDV societies are less inclined to default strategically since they are more guided by social norms. (Tajaddini & Gholipour, 2016)

The second factor is power distance (PDI) that measures the degree to which the less powerful members accept that power is not distributed in an equal way. On one hand, people in high PDI reality accept easily privileges, corrupt practices and unfair situations: that’s why even if they pass through a difficult economic situation, they could decide to avoid default and continue paying the mortgage. On the other hand, they could declare delinquency since they do not feel guilty for the consequences. (Tajaddini & Gholipour, 2016)

The third element that Tajaddini and Gholipour consider is uncertainty versus avoidance (UAI) that identifies the degree to which people feel uncomfortable with uncertainty. Members of high UAI societies tend to avoid or control risk and could

be less willing to default strategically since they result to be afraid of future consequences. A low UAI person is less anxious and will accept risk in a more relaxed way. (Tajaddini & Gholipour, 2016)

Another determinant studied is masculinity versus femininity (MAS) that expresses the degree to which these values are present in a country. In societies that exhibit lower MAS people tend to prefer coordination and solidarity and to evaluate in a better way financial decisions and future income, for these reasons the lower the MAS, the lower default on mortgage. (Tajaddini & Gholipour, 2016)

The fifth component is indulgence versus restraint (IND) that explores how members of a country are able to control their instinct. If the IND score is high people appear more willing to default since they are more likely to follow their impulses and to fail in correct allocation of financial resources. Spending more money than they could afford on leisure and less on saving. The lower the IND, the lower the probability of default since these realities impose strict regulations and social norms. (Tajaddini & Gholipour, 2016)

The last aspect analyzed is pragmatic versus normative (PRA). In societies where this score is low people are normative, more focused on the short-term horizon and they are less encouraged to save money for the future and prefer to focus on; while if the score is high members tend to be more pragmatic and interested in achieving long-term goal by saving and investing. The PRA score is negatively correlated to default: if the score is high, people that are oriented on long-term horizon would possess a larger amount of savings and would avoid risky mortgage contracts. (Tajaddini & Gholipour, 2016)

6. WHAT HAPPENED IN 2000S?

6.1 CORRELATION BETWEEN DEFAULT AND PREPAYMENT IN 2000S

The return on a mortgage is given by the expected cash flows that monthly are paid to the lender. The most significant risk that a lender should face is the cease of the cash flows that he receives; this could happen either because of default or because the borrower prepays the loan. Prepayment and default are not independent but are correlated in the sense that they could be defined as competing risks in determining the payoff; in fact, if one of the two options takes place, the other cannot occur. In general, homeowners consider default to have higher costs and for this reason are more likely to refinance or prepay if they experience financial difficulties or events like illness or job loss.

Figure 18 and 19 report data that are taken from the paper “Prepayment and Delinquency in the Mortgage Crisis Period”²⁵ written by Krainer and Laderman in 2011. They show the ratios of delinquency²⁶ and prepayment²⁷ for ARMs and FRMs originated between 2001 and 2008. Performances differ between the two types of mortgages: in particular, ARMs exhibit higher ratios both for what concerns prepayment and in default.

Concerning delinquency, figure 18 shows that the ratios remain stable on the 2 percent until 2003 and then start to grow up. The peak for FRMs is reached in 2007 with a probability of 10,6 percent while the highest point for ARMs can be observed in 2006 with a probability of 19,8 percent compared to 9,7 percent for FRMs in the same year. (Krainer & Laderman, 2011)

For what concerns prepayment rate exposed in figure 19, the peak could be pointed out in 2002 with a probability of 75,8 percent for fixed-rate mortgages and 90

²⁵ Krainer and Laderman analyzes around 770.000 first mortgages originated between 2001 and the first quarter of 2008 using LPS Applied Analytics. Between these mortgages around 600.000 are fixed-rate mortgages while the remaining 170.000 are adjustable-rate mortgages.

²⁶ A mortgage is considered delinquent in this case if it is 60 days late.

²⁷ In this text mortgage prepayments occurs when a borrower sells the house as well as when the borrower sells the property.

percent for adjustable-rate ones. From 2003 prepayment start to decrease and in 2007 the data display a 25,8 percent probability for FRMs and a 21,1 percent probability in the case of FRMs. (Krainer & Laderman, 2011)

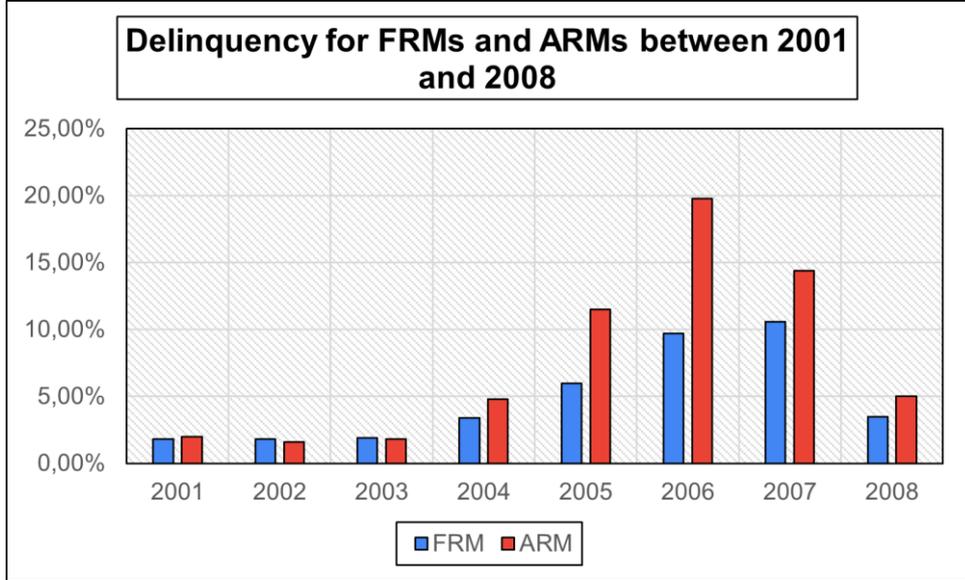


FIGURE 17: SHOWS THE INCREASE OF DELINQUENCY FOR FRMs AND ARMs FROM 2001 AND 2008. **SOURCE:** KRAINER, J., & LADERMAN, E. (2011, SEPTEMBER). “PREPAYMENT AND DELINQUENCY IN THE MORTGAGE CRISIS PERIOD”. *FEDERAL RESERVE BANK OF SAN FRANCISCO.*

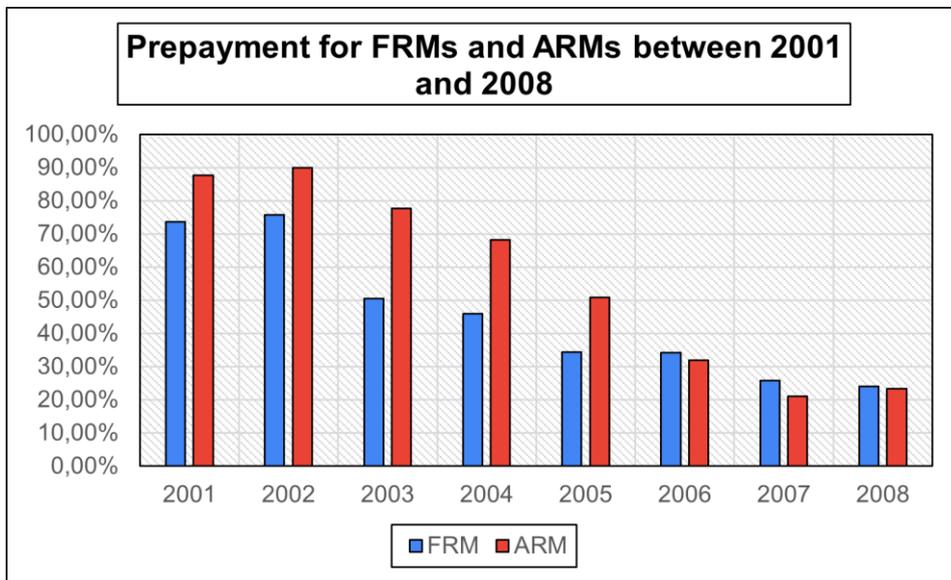


FIGURE 18: SHOWS THE DECREASE OF PREPAYMENT FOR FRMs AND ARMs BETWEEN 2001 AND 2008. **SOURCE:** KRAINER, J., & LADERMAN, E. (2011, SEPTEMBER). “PREPAYMENT AND DELINQUENCY IN THE MORTGAGE CRISIS PERIOD”. *FEDERAL RESERVE BANK OF SAN FRANCISCO.*

The authors try to understand if there is a correlation between the decrease of prepayment and the increase of mortgage default that could be observed around 2005-2007.

One of the main reasons that push borrower to refinance is to reduce the interest rate on the mortgage as well as to change the contract terms by passing from an adjustable-rate mortgage to a fixed-rate one. Another motive to prepay in particular for ARM borrowers that have initially teaser rates and then higher payments due to higher rates, is no longer to be financially constrained and to benefit from lower mortgage rates.

The authors sustain that the decrease of prepayment that characterize the 2000s is linked to an inability to prepay: a higher proportion of borrower who took out mortgages in particular in 2005, 2006 and 2007 would have prepaid than actually happen. In this period house prices fall, consequently LTV increases and for borrowers became more difficult to prepay. (Krainer & Laderman, 2011)

Then, a large percentage of the mortgage taken out in the 2000s and in particular 20 percent of those made in 2007, were made by subprime borrowers that refer to people with financial distress and with poor credit history including delinquent payments. Subprime mortgages were considered as credit repair contracts and, due to the expectation that house price would increase considerably in the future, resulted very attractive. Default probability arose in 2000s because of the fact that subprimers weren't reliable borrower and were more likely to face economic difficulties in paying back the mortgage. Especially homeowners that had a low FICO score²⁸ experienced higher delinquency rate compared to those with a higher score since they were financially vulnerable and appeared to be incapable to prepay. (Krainer & Laderman, 2011)

²⁸ The FICO score is a credit score created by the Fair Isaac Corporation. This score is between 300 and 850 and it consider payment history, level of indebtedness, type and length of credit used. If people pay late and apply new credit not wisely their credit score will decrease. A FICO score between 670 and 740 are considered normal while if FICO score is below this range the borrower is considered as risky and lenders would be less likely to take out a mortgage.

6.2 INFLATION AND INTEREST RATES

Interest rates change over time and are regulated by the Central Bank that decides to increase or decrease them considering the economic situation and analyzing several factors such as inflation, supply and demand, fiscal deficit and banking system. This results in transforming the monthly payments of adjustable-rate mortgage that are not fixed and has an impact on the choice of borrowers that have to decide which type of mortgage to apply for. Even if it is difficult to predict in the long-run how interest rates will vary, understanding how inflation is correlated to their modification could help people that want to buy a house.

Inflation happens in a situation where there is a general increase in prices of goods and services. This brings to a fall in the purchasing power that could be defined as the value of a currency and identifies the number of goods and services that people can purchase with one unit. Inflation is directly proportional to money supply in the sense that if the currency that are used increases, demand becomes higher and a growth in prices occurs to avoid shortage of supply, while if money supply declines, also inflation decreases.

Inflation is regulated by a Central Bank (FED in the case of US and BCE for Europe) that try to maintain the most appropriate balance between supply and demand. Since interest rates are the primary factor that central banks use to manage inflation, usually these two elements move in the same direction.

Central banks tend to increase interest rates when the level of inflation is growing; in this way consumers prefer to save rather than spend and are less inclined to buy and to invest particularly in expensive property like houses. Consequently, less currency circulates, demand for goods and services goes down and the level of inflation is expected to decrease.

In a scenario of a weak economy instead, to stimulate the circulation of currency and the increase of inflation central banks lower the interest rate to make people spend more than how much they save and buy and invest more encouraged by the lower interests that are applied. In this way consumers spend more, and demand grows up.

Inflation has also some positive aspects: in fact, it could be an advantage for borrowers since if they already owned money before the rise of inflation, they still are in debt of the same amount, but they hold more money that they can use to pay off the debt earlier. Inflation makes the value of money decline over time; this means that when inflation happens, cash that now have a certain value will be less worth in the future. On one hand debtor can benefit from this since for this reason they pay back lenders with money that have a lower value than when the mortgage was created. On the other hand, this is disadvantageous for people that possess lots of saving since their money are worth value over time. (Segal, 2022)

Central banks try to anticipate future trend of inflation and decide for the most appropriate interest rate to apply but often there is a lag between the movement of inflation and the right reaction. In this way growth of inflation could be blocked by interest rates that are too high or on the contrary the yield to low could make inflation grow too much. (Folger, 2022)

Figure 20 displays the evolution of EURIBOR, IRS and inflation from 2003 to 2022.



FIGURE 19: SHOWS THE EVOLUTION OF EURIBOR, IRS AND INFLATION BETWEEN 2003 AND 2022 DATA SOURCE: IL SOLE 24 ORE ²⁹

²⁹ The data are taken from the website ilsole24ore.com.

EURIBOR results to be in general lower than IRS reaching also negative values from 2015 and 2022 and the gap between the two was on average 1,5 percent. An explanation for this fact could be that choosing fixed-rate mortgage borrowers have fixed payments and avoid the risk of fluctuation of the market that change interest rate; IRS is higher since people are bearing some of the market risks and pay for the fact that there isn't uncertainty, and they are sure of how much they are going to pay in the future.

By evaluating interest rate as the sum of an index (EURIBOR for what concerns adjustable-rate mortgages and IRS for fixed-rate ones) and the spread that is the profit that the bank obtains by lending the money, the graph shows that people are more encouraged to apply for an adjustable-rate mortgage that presents lower interests and consequently lower monthly fees. For example, considering the 2018 EURIBOR had negative value of -0,37 percent while IRS was 1,579 percent and this resulted in a consistent different in monthly payments. However, during the crisis of 2006-2008 the two indexes were very close and in particular in 2009 EURIBOR become higher than IRS; this was due to a rapid and significant growth in inflation that brought Central Bank of Europe to increase interests to make inflation decrease.

CONSLUSIONS

Mortgages result to be a fundamental instrument that people use to finance the purchase of a house. This document after having underlined the substantial differences between fixed-rate mortgages that are characterized by constant payments and adjustable-rate ones, that use interest rates follow the market, studies Campbell model made in 2003.

Default became particularly frequent after the housing boom crush of 2008 both because interest rates increased rapidly in 2006 and cause a considerable part of mortgage in that period were opened to subprime borrowers that are high credit risk lenders with poor credit history. Default depends not only on negative home equity but also on how borrowers are constrained by low current resources. Delinquency is more probable with larger house price decline, lower income and an increase of initial interest rate. In the case of ARMs default is more common if interest rates are higher while the opposite happens for FRMs.

Concerning prepayment, it results to be higher in general for ARMs than for FRMs and is more common the level of home equity and the loan size are higher.

The loan-to-value (LTV) and the loan-to-income (LTI) that are rates that measure respectively the level of risk and the affordability of a mortgage are presented. The text show that the lower LTI and the lower LTV, the lower the probability of default while cash-out rate decreases with a lower LTI and increase with a Lower LTV.

Complex mortgages are an alternative born in 2000s and identify different adjustable-rate contracts that present lower payments during the teaser period and are used to finance more expensive properties. These contracts are chosen by borrowers that can face increased rate and expect growing income; they are characterized by higher house value, loan amount and value-to-income. CMs have higher probability to be delinquent after 3 years correlated to ARMs and FRMs and prepayment for complex mortgages is less probable than for adjustable-rate contracts but more than what happens for fixed-rate ones.

The document introduces strategic default that identify the deliberate decision of stop making payments. This option is influenced by pecuniary determinants such as negative home equity and relocation costs but also by non-pecuniary factors. For instance, if borrowers consider walking away as morally wrong, they would be less inclined to do it; if they are emotionally attached to the property, the delinquency ratio decreases, and the opposite occurs if they have bad economical expectations for the future. Moreover, risk-averse people are less inclined to walk away and the higher the expectation of growing of house prices, the lower the default rate. In societies characterized by individualism, lower power distance, uncertainty, indulgence the default rate is higher.

The text shows the correlation between inflation and interest rates: the latter are increased where inflation is growing and are decreased in a scenario of weak economy. Then, the EURIBOR and IRS index used respectively to determine the interest rate for ARMs and FRMs are presented from 2003 showing that in general EURIBOR results to be lower than IRS.

A good point of reflection or the future studies could be to explore the possibility to refinance the mortgage analyzing the right timing to do it. It could be also interesting to examine how inflation, EURIBOR and IRS index will evolve in the future and if they will continue to grow up or will reverse their trends.

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