What homebuyers need to know about the differential risk of mortgages

Larry J. Prather[1]
Department of Accounting and Finance
Southeastern Oklahoma State University
Durant, OK 74701, USA.

Che-Chun Lin
Department of Quantitative Finance
National Tsing Hua University
Hsin-Chu 30013, Taiwan

Ting-Heng Chu
Department of Economics and Finance
East Tennessee State University
Johnson City, TN, 37614, USA

Abstract

Because homeownership represents the largest investment many individuals make, and the risks of competing mortgage products are not well understood, we develop a framework to quantify credit risks of mortgage products. We use simulations to examine the default rates of five types of mortgage products under both a normal and stressed economy to examine risk differences among the competing mortgage products. Results suggest that significant default risk differences exist between mortgage products. As a result, in addition to considering characteristics such as differential interest rates, points and fees, and the term of a mortgage, homebuyers should consider the risk differential of competing mortgage products before selecting a mortgage.

JEL classification: G21; G17

Keywords: Home mortgages; Default risk; Mortgage products

1. Introduction

Choosing the best mortgage to finance your home purchase can be an almost overwhelming task. While traditionally homebuyers had only fixed rate mortgages (FRMs) to consider, today numerous types of mortgage loans are available from which to choose. There is also plenty of research devoted to assisting homebuyers in making the best choice.

Articles such as Herman and Lloyd (1995) are readily available that explain important, and sometimes complex, loan terms and characteristics. Moreover, research abounds that provides guidance in choosing between FRMs and adjustable rate mortgages (ARMs) (Dhillon, Shilling, and Sirmans (1987)), the tradeoff between points and mortgage rates (Yang (1992), and the choice between 15-year and 30-year loans (e.g., Dhillon, Shilling, and Sirmans, 1990; Phillips, Rosenblatt, and Vanderhoff, 1992; Janjigian, 1994; Vruwink and Gisher, 1995; Goff and Cox, 1998; Kistner, 1998 & 2001; Tomlinson, 2002; Basciano, Grayson, and Walton, 2006; and Baek and Bilbeisi, 2011). Moreover, Lee and Hogarth (2000) find that 78% of people seeking a home loan compare interest rates, 76% compare the type of loan, and 54-65% compare fees.

Comparing loan terms is a good start in comparing mortgages because the choices above highlight that the best mortgage choice for a given homebuyer is complex and depends on a multitude of factors such as their marginal tax rate, risk tolerance, expected length of the homeownership period, and investment opportunities. Research also details how changes in borrower characteristics would, or should, affect loan choice. However, the research above primarily focuses on the best financial outcome in terms of an extended time-value-of-money type of approach without considering crucial risk differences among mortgage loans.

However, risk differences may be important as well and the importance of these differences may have increase with the introduction of numerous non-traditional mortgage products (NMPs) during the last decade. These NMPs entail creative features such as hybrid fixed-rate and adjustable-rate periods and provide various payment options for borrowers which can cause payments to increase in the future to a point where the homebuyer can no longer afford to make the payment.

Not only are NMPs a concern, but Campbell and Cocco (2003), Miles (2004 & 2005), and Miles and Pillonca (2007) suggest that while ARM contracts generally enhance the affordability of a home purchase, ARMs carry higher credit risk than FRMs. Unfortunately, there is a paucity of studies that consider the impact of key economic risk factors on various types of mortgage loans. While Follain (1990) discusses sources of uncertainty such as future interest rates, housing prices, and economic conditions, few studies (e.g., Yang, Buist, and Megbolugbe, 1998; and Buist and Yang, 1998) explicitly deal with important variables such as income volatility, home price changes, and interest rate changes to analyze the default risk of mortgage contracts. We attempt to fill that gap by using the simulation framework of Buist and Yang (1998) to compare various NMPs with their counterparts in the conventional mortgage market.

We have two research objectives. First, we assess different mortgage types in terms of the two drivers of default risk – the probability of negative equity (PnegQ) and the probability of a liquidity shortage (PSHORT). Following Yang, Buist, and Megbolugbe (1998), we analyze the probability of default as the probability of both events occurring simultaneously. Second, we use Monte Carlo simulations with three correlated stochastic variables (mortgage interest rate, home price, and household income) to determine the default risk of various ARM and FRM contracts under normal and stressed economies. The results show that NMPs improve income affordability at the cost of higher credit risk.

The remainder of the paper is organized as follows. Section 2 provides background information and Section 3 presents the model and details the sample of products being analyzed. Section 4 presents the results of our simulations under a variety of economic conditions. Section 5 concludes.

2. Background

2.1. Mortgage risk

A mortgage is a personal loan collateralized by the borrower's home. The ability of the borrower to pay the monthly payment has been considered to be one of the most important credit risk factors and a mortgage should not default if the borrower can afford to pay the monthly payment. An "ability-to-pay problem" occurs when the borrower cannot afford to pay the required payment. Ability-to-pay problems are typically managed at mortgage origination by setting maximum allowable payment-to-income ratios (PTI). While PTI can be controlled at mortgage origination, PTI can change over time due to economic events that cause income to change or mortgage terms that cause future payments to change.

Another risk comes from option theory and suggests that a borrower would have an incentive to default when the unpaid mortgage principal balance (UPB) exceeds the market value of the house used as collateral. Defaults caused by negative equity are referred to as "willingness-to-pay problems." Willingness-to-pay problems are managed at mortgage origination by setting a maximum allowable loan-to-value ratio (LTV) which is intended to mitigate negative equity situations. While current LTV ratios can be controlled at mortgage origination, future economic condition will influence the future home price and mortgage terms will influence the future UPB. Thus, future LTV ratios depend on both mortgage terms and future economic conditions.

Future ability-to-pay and willingness-to-pay problems are functions of mortgage characteristics and future economic conditions. While homebuyers may not be able to control future economic conditions, they need to understand that risk exists. Moreover, because mortgage terms differ, the risk of ability-to-pay and willingness-to-pay problems will differ with the mortgage that the homebuyer chooses. Therefore, it would be informative to examine the relationship between mortgage characteristics and future ability-to-pay and willingness-to-pay problems of typical mortgage contracts under normal economic conditions and under a "stressed" economy.

2.2. Mortgage affordability

One approach to improve affordability is to encourage borrowers to use ARMs instead of FRMs. Because lenders do not face interest rate risk, ARMs can be offered at lower interest rates than FRMs. Thus, borrowers receive lower monthly payments and therefore face lower income requirements. Most ARMs offered in recent years come with a "teaser" rate, which is a low rate for the beginning period. This approach was later modified to include an option payment ARM where the borrower has the option to determine the size of the monthly payment. The payment options range from a full amortization payment to a minimum payment that is not sufficient to cover the interest obligation. If the borrower chooses to make the minimum payment, the unpaid portion of the interest obligation is added to the mortgage balance, causing negative amortization. This product carries very low initial interest rates so that borrowers with limited income can qualify.

2.3. Evolution of the mortgage market

Dhillon, Shilling, and Sirmans (1987) reported that the market share of ARMs increased from about 8% in 1981 to a peak of 65% in 1984. In 2005, ARMs accounted from about 50% of mortgages originated. We have also seen the rise of various specialized ARM products such as 2/28 and 3/27 Hybrid ARMs, negative amortization mortgages, option payment ARMs, and more conventional 3/1 or 5/1 ARMs with a cap structure. These NMPs pose a challenge in terms of assessing their risk. Due to the newness of those products, there is lack of performance data which prevents gauging the extent of the risks posed by these products in different stages of the economic cycle.

Characteristics of 2/28 and 3/27 mortgages make them difficult to properly value and they can be extremely risky. These hybrid mortgages feature a fixed rate for two or three years, respectively, which depends jointly on prevailing interest rates and the borrower's credit rating. After the fixed period, the interest rate typically jumps and resets periodically afterward. This feature creates a potential ability-to-pay problem.

Several studies link mortgage choice to macroeconomic outcomes, by employing a life-cycle consumer choice model (e.g., Campbell and Cocco, 2003; Miles, 2004) or by examining the mortgage choice issue in an industrial organization perspective (Vickery, 2007; Wyman, 2005). ARM contracts create an income (or consumption) risk for a borrower that is caused by short-term variability in the real payments that correspond to changes in the indexed interest rate. Interest rate changes can cause significant payment shocks in an increasing rate environment which in turn can increase mortgage default risk. Consumer myopia plays an important role in mortgage choice because a typical borrower may have a poor understanding of interest rate risk and risk profiles of different mortgage products. The initial teaser rates in ARM contracts may be viewed as attractive to borrowers at the initial stage, but can increase the likelihood of payment shock and default risk.

Existing research that is most relevant to this paper examines the mortgage product choice in the context of loan termination and default-prepayment risks (e.g., Cunningham and Capone, 1990; Stanton and Wallace, 1995; Ambrose and LaCoure-Little, 2001; Calhoun and Deng, 2002; Ambrose, LaCoure-Little, and Huszar, 2005). These studies indicate that hybrid ARMs experience relatively high default rates, which would be an expected outcome with a payment shock at the time of rate adjustment. The most recent extension in this area is LaCoure-Little and Yang's (2010) finding that deferred amortization contracts are more prevalent in booming housing markets. Moreover, those mortgages default more often, particularly among lower-income borrowers with aggressive consumption levels.

3. Selected Mortgage Products and the Simulation Parameters

3.1. Mortgage characteristics and differential default risk

To provide a broad cross-section of widely-used mortgage products that represent mortgages that consumers must choose among, we investigate five competing types of mortgage products. These five types of mortgages will present a representative example of mortgages that will have different payments over time due to differential initial interest rates, differential future interest rates during the tenure of the loan, and differential payment terms that are dictated by the type of the loan. The five mortgage types we selected are: (1) 30-year fully amortized fixed rate mortgages (FRMs), (2) 30-year fully amortized adjustable rate mortgages (ARMs) with an annual reset frequency and no cap, (3) 30-year fully amortized ARMs with an annual reset frequency and a 5/1/1 cap, (4) 30-year hybrid 2/28 ARMs with an assumed initial fixed rate of 3% for first 2 years, and an interest rate that will reset at the benchmark index rate plus 2.75% and, (5) 30-year option payment ARMs where a minimum payment is made in the first five years that results in negative amortization during the minimum payment period. The initial contract rate for the option payment ARM is 3% and the margin is 2.75%. The rate will and principal amortization will begin at the end of 5th year and there is a 7.5% annual payment cap.

Choosing mortgage types that have differential payments over time is important because finance literature suggests that mortgage defaults are generally caused by ability-to-pay problems and/or willingness-to-pay problems. An ability-to-pay problem occurs when the borrower lacks sufficient income to make the monthly mortgage payment. One facet of an ability to pay problem is the size of the payment stream at any point in time. Thus, because the required payment over time varies with the characteristics of a given loan, ability to pay problems will differ for our selected loan products.

Willingness-to-pay problems refers to the situation where the value of the mortgaged house falls below the unpaid principle balance (UPB) of the house to the extent that the borrower has the incentive to quit making payments and letting the lender take over the collateral house. Willingness to pay problems can differ among our selected loan products as well because the amortization of principle can differ, causing the UPB to differ among loan products at different points of time during the tenure of the loan.

Yang, Buist, and Megbolugbe (1998) and Elmer and Seelip (1999) argued that the willingness-to-pay problem is a necessary but not a sufficient condition to trigger mortgage defaults. Given the severe consequences of default, most borrowers would not default on a mortgage unless they are subject to both an ability-to-pay problem and a willingness-to-pay problem. Therefore, we follow the analytical framework of Buist and Yang (1998) to investigate the default risk embedded in various mortgage product types.

3.2. Simulating default risk for selected mortgage products

In order to examine willingness-to-pay problems, we use a framework that is similar to Calhoun and Deng (2002) and Yang, Lin, and Cho (2011) by defining the probability of negative equity (PnegQ) as the probability that the UPB of the mortgage is greater than the value of the collateral house (H). PnegQ is closely related to the current loan-to-value (CLTV) ratio of a mortgage and a CLTV ratio above 1.0 would indicate negative equity.

In order to examine ability-to-pay problems, we use the probability of a payment shortage (PSHORT) occurring. We define (PSHORT) as the probability that the borrower's income will be insufficient to support the borrower's minimum living expenses and mortgage payments at any given time. When normalized, PSHORT is closely related to the current payment-to-income ratio of a mortgage. As the mortgage payment becomes larger, ability-to-pay problems occur. Similar to Buist and Yang (1998), we assume that default occurs if and only if both events occur simultaneously.

PnegQ and PSHORT are determined by three stochastic state variables; (1) the mortgage interest rate, (2) the home price growth rate, and (3) the household income growth rate (or their intertemporal changes designated as [r, $\frac{dH}{H}, \frac{dY}{Y}$], respectively). We assume these three risk factors r, H, Y follow stochastic processes.

The interest rate, equation (1), follows a Cox-Ingersoll-Ross (1985) mean-reverting square root process, where α is the mean-reverting speed, μ_r is the long term mean reverting level, and σ_r is the volatility. It is a macro-economic variable that affects all mortgage loans and involves no idiosyncratic risk.

$$dr = \alpha(\mu_r - r)dt + \sigma_r \sqrt{r} dz_r \tag{1}$$

Following Yang, Lin, and Cho (2011), we assume that the house price growth rate follows a two factor process (equation (2)). The first factor, h_1, captures the variability of the local market's house price index appreciation rate (HPA) and H_1 follows a geometric Brownian motion (log-normal process) with mean μ_{H_1} and volatility σ_{H_1}. The second factor, h_2, captures the dispersion of individual house appreciation rates from local HPA and H_2 follows a geometric Brownian motion with mean zero and volatility σ_{H_2}.

$$\begin{aligned} \frac{dH}{H} &= \frac{dH_1}{H_1} + \frac{dH_2}{H_2} = h_1 + h_2 \\ \frac{dH_1}{H_1} &= \mu_{H_1} dt + \sigma_{H_1} dz_{H_1}; \frac{dH_2}{H_2} = \sigma_{H_2} dz_{H_2} \end{aligned} \tag{2}$$

Equation (3) presents the household income growth rates to capture the variability of the local market's income growth rate (y_1) and the dispersion of a particular household's income growth rate from the local market average (y_2). The Y_1 follows a geometric Brownian motion (log-normal process) with mean μ_{Y_1} and volatility σ_{Y_1} and the Y_2 follows a geometric Brownian motion with mean zero and volatility σ_{Y_2}.

$$\begin{aligned} \frac{dY}{Y} &= \frac{dY_1}{Y_1} + \frac{dY_2}{Y_2} = y_1 + y_2 \\ \frac{dY_1}{Y_1} &= \mu_{Y_1} dt + \sigma_{Y_1} dz_{Y_1}; \frac{dY_2}{Y_2} = \sigma_{Y_2} dz_{Y_2} \end{aligned} \tag{3}$$

$z_r, z_{H_1}, z_{Y_1}, z_{H_2}, z_{Y_2}$ are five standard Weiner processes with the following correlation matrix:

$$\sum = \begin{bmatrix} 1 & \rho_{r,H_1} & \rho_{r,Y_1} & 0 & 0 \\ \rho_{r,H_1} & 1 & \rho_{H_1,Y_1} & 0 & 0 \\ \rho_{r,Y_1} & \rho_{H_1,Y_1} & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & \rho_{H_2,Y_2} \\ 0 & 0 & 0 & \rho_{H_2,Y_2} & 1 \end{bmatrix}. \tag{4}$$

The matrix in equation (4) assumes that correlations exist among the systematic risks (the interest rate, the local HPA, and the average household income growth rate in the area (z_r, z_{H_1}, and z_{Y_1})), respectively. The risks z_{H_2} and z_{Y_2} are independent from the systematic risks. However, a correlation exists between the dispersion of a single house's appreciation rate from the local HPA and the dispersion of a particular household's income growth rate from the local average income growth rate. Intuitively, they are positively correlated because a lower income household is more likely to under-maintain the house, causing the house to suffer above average physical deterioration. As a result, the appreciation rate of the house would be lower than other houses in the same local market.

Under a discrete time framework, the three stochastic risk factors can be rewritten as the following orthogonal processes (see Buist and Yang (1998)):

$$\Delta r_t = (\alpha + q)(\mu_r - r_{t-1}) + \xi_r \sigma_r \sqrt{r_{t-1}} \tag{5}$$

$$\Delta H_t = \mu_{H_1} + \xi_{H_1} \sigma_{H_1} + \xi_{H_2} \sigma_{H_2} \tag{6}$$

$$\Delta Y_t = \mu_{Y_1} + \xi_{Y_1} \sigma_{Y_1} + \xi_{Y_2} \sigma_{Y_2} \tag{7}$$

where q is the interest rate risk premium and the correlated shocks (ξ) can be rewritten in an orthogonized system as:

$$\xi_r = \eta_r \tag{8}$$

$$\xi_{H_1} = \rho_{r,H_1}\eta_r + \sqrt{1-\rho^2_{r,H_1}}\,\eta_{H_1} \tag{9}$$

$$\xi_{Y_1} = \rho_{r,H_1}\eta_r + \frac{(\rho_{H_1,Y_1} - \rho_{r,H_1}\rho_{r,Y_1})}{\sqrt{1-\rho^2_{r,H_1}}}\eta_{H_1} + \frac{\sqrt{1-\rho^2_{r,Y_1}}\sqrt{1-\rho^2_{r,H_1}}}{(\rho_{H_1,Y_1} - \rho_{r,H_1}\rho_{r,Y_1})}\eta_{Y_1} \tag{10}$$

$$\xi_{H_2} = \eta_{H_2} \tag{11}$$

$$\xi_{Y_2} = \rho_{H_2,Y_2}\eta_{H_2} + \sqrt{1-\rho^2_{H_2,Y_2}}\,\eta_{Y_2} \tag{12}$$

and η's represents an independent random standard normal variable.

Parameters used in our simulations are described as follows (Buist and Yang, 1998[2]; and Yang, Lin, and Cho, 2011[3]; provide justification for specific values):

- Long-term means and volatilities: μ_r = 0.065, σ_r = 0.15; μ_{H_1} = 0.05, σ_{H_1} = 0.06, σ_{H_2} = 0.08; μ_{Y_1} = 0.035, σ_{Y_1} = 0.05, σ_{Y_2} = 0.07;
- Pair-wise correlations: ρ_{r,H_1} = 0.4, ρ_{r,Y_1} = 0.7, ρ_{H_1,Y_1} = 0.6, and ρ_{H_2,Y_2} = 0.1.

The assumptions and estimates provide initial values for our model's parameters and enable us to construct future economic shocks using Monte Carlo simulation. The parameter values represented as [μ_{H_1} , σ_{H_1} , σ_{H_2}] for the house appreciation rate were imputed based on the annualized estimates Yang, Lin, and Cho (2011) estimate the quarterly μ_{H_1} , σ_{H_1} , σ_{H_2} to be 0.0139, 0.0303, and 0.0409, respectively.

As for the parameter values represented as [μ_{Y_1} , σ_{Y_1} , σ_{Y_2}] for the household income growth rate, μ_{Y_1} and σ_{Y_1} can be observed from the market, but σ_{Y_2} is unobserved and thus an assumed value must be used. Similar to Yang, Lin, and Cho (2011), we compute the parameter values for the household income growth rate and its variability using data from state household income, published by U.S. Census Bureau at year 2008.

4. Results

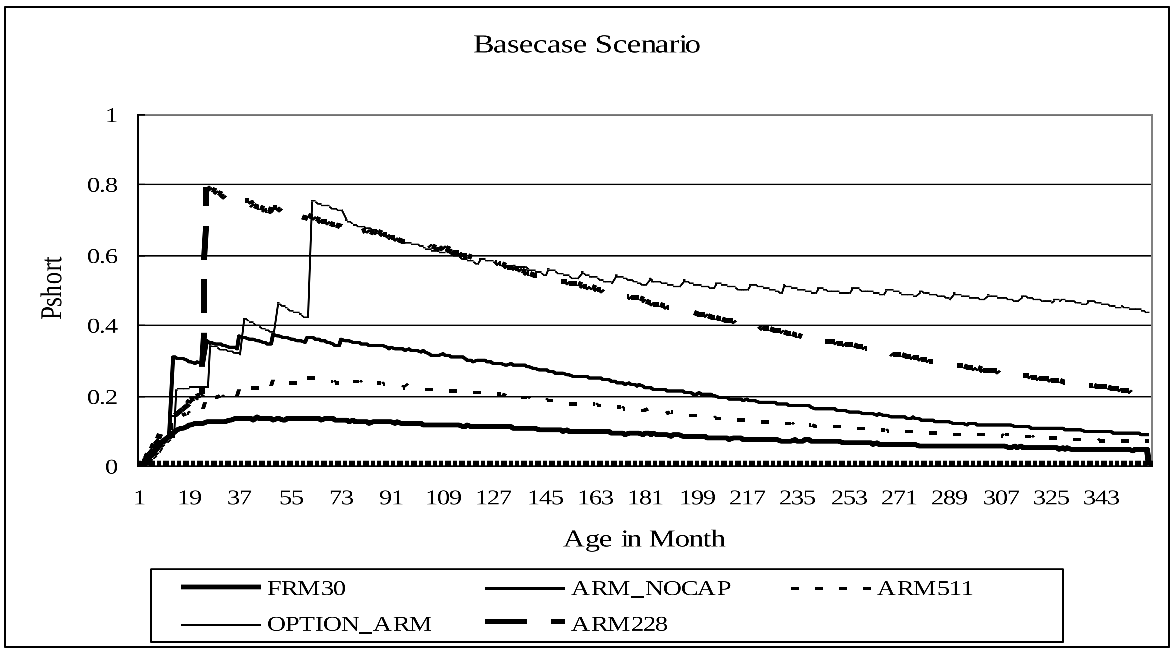
We simulate the correlated state variables, as specified in equations (5) through (7), with 10,000 paths. We define a stressed economy in terms of changes in home price growth rates, household income growth rates, and mortgage interest rates and compare the results from a normal economy to those of the stressed economy. For a stressed economy, we use shock assumptions on interest rates, home prices and household income. The interest rate shock requires testing an increase in the mean growth rate of interest rates by their own standard deviation during a 2-year window after origination. Likewise, home price and household income shocks are modeled as a reduction in their respective mean growth rates by their standard deviations during a 2-year window after origination. The shocks of each series will revert to their respective normal-economy level after two years from origination and remain constant throughout the loan life.

These simulated economic paths are developed for the five types of mortgage contracts being analyzed and Figures 1 through 4 show the key results in terms of the estimated PSHORT and PBOTH (probability of default) trends over the loan lives.

4.1. Differential ability-to-pay problems

Differential ability-to-pay problems are illustrated in Figures 1 and 2 which present PSHORT trends under normal and stressed economies, respectively. Figure 1 reveals that the loan products have the same PSHORT values in the first year because we assume annual rate adjustments. However, after the initial period, ARMs begin showing discrete jumps in PSHORT. The PSHORT pattern reveals that FRMs exhibit the lowest PSHORT, followed by ARMs with a 5/1/1 cap structure, and ARMs with no caps. Thus, these various types of mortgages exhibit differential risk to borrowers in terms of the borrowers' future ability to pay.

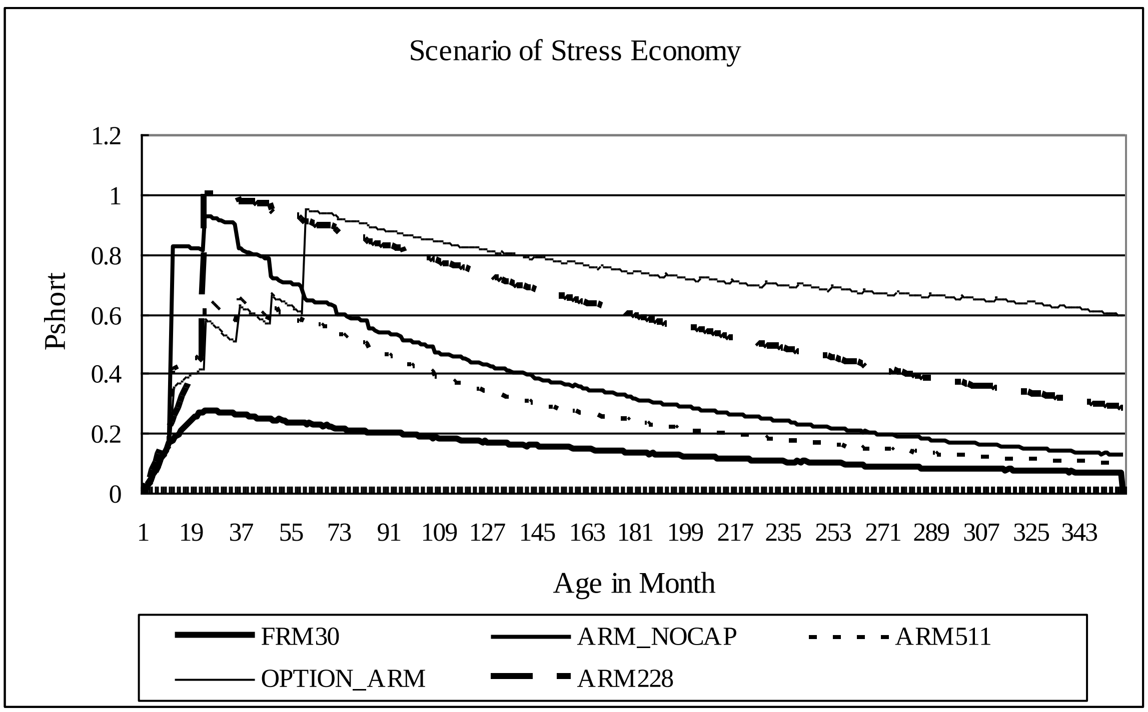
Figure 1. PSHORT Trends (Non-Stressed Economy)



PSHORT trends of option ARMs and 2/28 ARM products reveals that they exhibit discrete jumps at the rate reset points (second year). However, a more alarming feature is that the PSHORT of these products is more than twice as large as the PSHORT for any of the other products that we examined.

At this point it is tempting to say that the results we present are not surprising. After all, FRMs should be the least risky because the payment is fixed for life (no payment shock). Also, ARMs with a 5/1/1 cap structure should be less risky than ARMs with no caps because the payment shock is limited by the product design. The risk of option ARMs is that the borrower may choose to make payments that are less than fully amortizing which increases the probability of negative equity. This also complicates a refinancing option in an increasing interest rate environment, or a down housing market, because the required monthly payments would increase. Loans with teaser rates such as option ARMs and 228 ARMs are more risky because interest rates can increase causing a future payment shock. However, what we find surprising is the high PSHORT for many of these loans and the vast differences in PSHORT among them in a non-stressed economy.

Figure 2. PSHORT Trends (Stressed Economy)



Unsurprisingly, a stressed economy increases PSHORT values for all mortgage products. However, the magnitude of increase in PSHORT for most products is alarming. For example, 5/1/1 ARMs with a cap structure show a PSHORT that is 3.3 times higher than in a normal economy, ARMs without a cap structure have a PSHORT that is 2.8 times higher , FRMs have a PSHORT that is 2.3 times higher, and option ARMs have a PSHORT that is 1.8 times higher. Due to the already high PSHORT for 2/28 ARMs, the increase in PSHORT is small in percentage terms; however, in terms of absolute magnitude, the PSHORT is nearly one.

4.2. Differential probability of default

The probability of default (PD) is triggered by two events, negative equity and ability-to-pay problems. As illustrated in Figure 3, the non-stressed PD trends for most loan products peak at similar levels after two years of seasoning. After that period, 2/28 and option ARMs exhibit a higher likelihood of default than other products. This outcome for 2/28 ARMs is due to the large payment shock; whereas, for option ARMs, it is primarily caused by the negative amortization feature of that product (the UPB is most likely to exceed the UPB at loan origination). ARMs without a cap structure consistently show a higher PD than their counterparts with a cap structure. The PD value is less than 10 percent, except for 2/28 and option ARMs. Judging from the PD estimates, option ARMs are the riskiest products, followed by 2/28 ARMs and 5/1/1 ARMs. The PD values for option ARMs peak at nearly 15 percent while 2/28 ARMs peak around 14 percent. While the relative PD ranking was expected, the magnitude of the PDs, and PD differentials, during a non-stressed economy was surprising.

Compared to normal-economy outcomes, PD values under a stressed economy exhibit a longer ramping-up period. The exception is 2/28, and option ARMs. The PD for 2/28 ARMs peak in the second year more than a 60 percent chance of default. The PD for option ARMs peaks around the 5th year above 60 percent compared to 15 percent under the non-stressed economy. Other loan products also show higher PD values under the stressed economy than

Figure 3. PD Trends (Non-Stressed Economy)

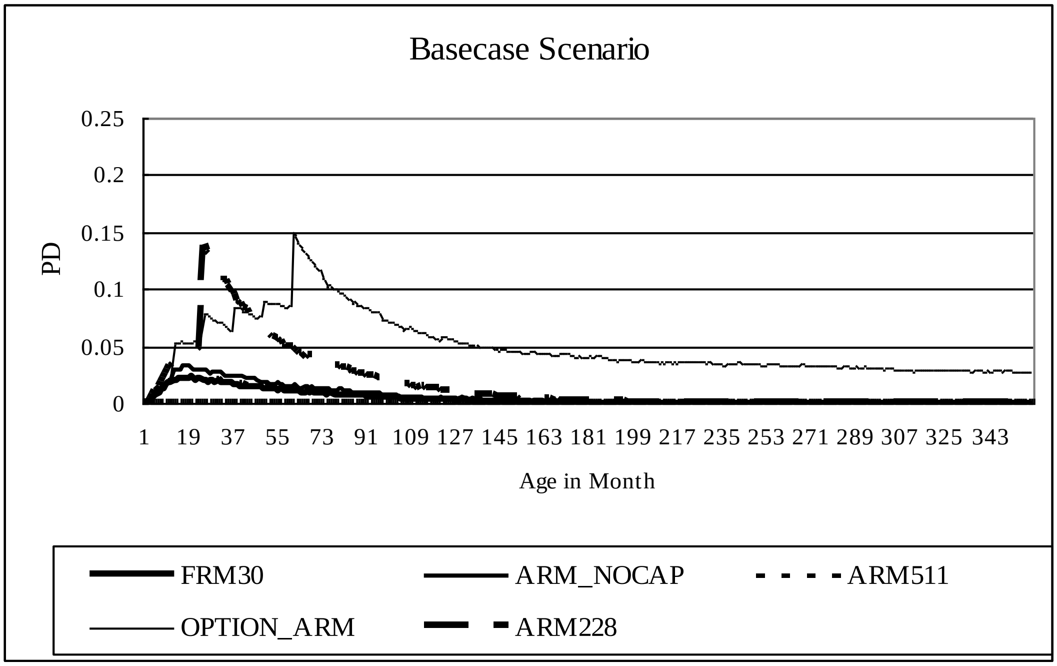
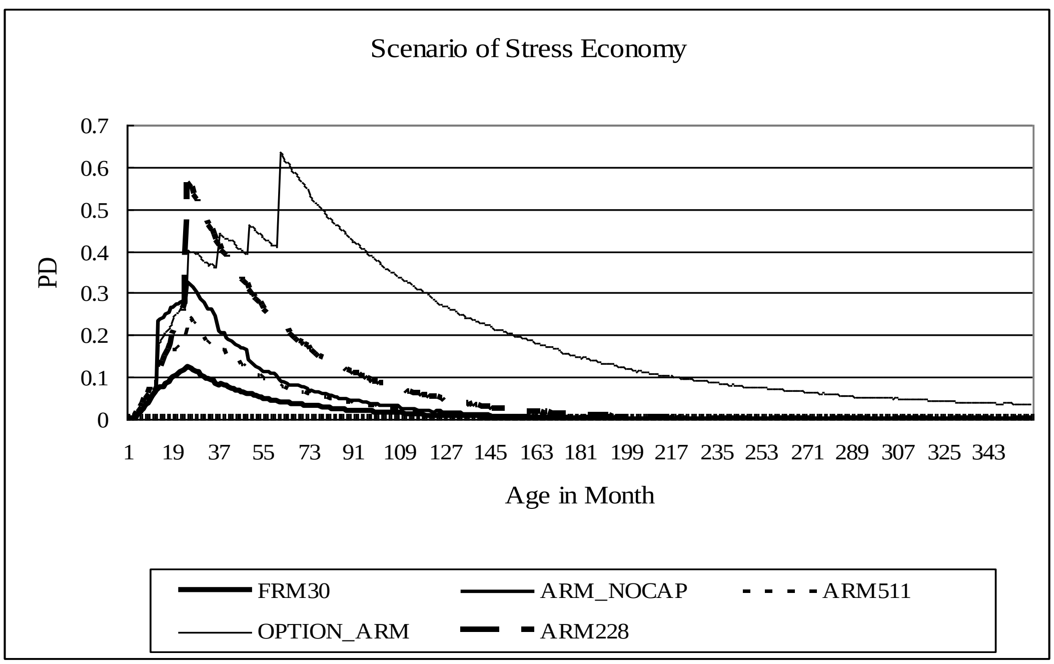


Figure 4. PD Trends (Stressed Economy)



under the baseline economy. The risk-ranking from highest to lowest is option ARMs, 2/28 ARMs, ARM with no caps, 5/1/1 ARMs, and FRMs. Again, while the relative PDs were not surprising, the differences in the magnitudes of the PDs between the stressed and non-stressed scenarios were surprisingly large.

Table 1 presents the average cumulative PD during the first 5 years for individual mortgages. The base PD Multiplier shows that 2/28 and option ARMs are about 4.1 and 3.9 times riskier than a standard FRM, respectively. However, the base PD of a 5/1/1/ ARM is only marginally higher than that of an otherwise similar FRM. The stressed PD Multiplier shows that the dispersion of PDs among loan products increases under the stressed economy. An ARM with no cap has a PD that is about 2.5 times that of a FRM. This evidence suggests that a significant default risk differential exists among competing mortgage products and that risk is exacerbated by economic scenarios that examine a stressed economy.

Table 1. Probability of Default among Products

Product	PD (Base)	PD Multiplier (Base)	PD (Stressed)	PD Multiplier (Stressed)
FRM30	1.54%	1	7.03%	1
ARM_NOCAP	2.08%	1.36	17.47%	2.49
ARM511	1.58%	1.03	12.64%	1.80
OPTION ARM	6.06%	3.94	30.00%	4.27
ARM228	6.23%	4.06	27.10%	3.86

5. Conclusion

Buying a home is often the largest investment that a person makes during their lifetime, so the choice of a home and how to finance that home can have significant and long-lasting financial implications for the purchaser. Home purchases can also have important emotional elements because the home buyer may find the “perfect” house and want the deal to work out so badly that they will go to great lengths to make the deal work. Unfortunately, this can lead to suboptimal financial decisions. Not only does a buyer face overpaying for a home, the buyer risks making a poor choice concerning the type of mortgage used to finance the home. For example, a buyer may choose a seemingly "affordable" loan type that contains potentially negative characteristics without due regard for potential risk.

Selecting a mortgage can be a difficult task. While it is important to compare the interest rates and payment terms of competing loan types, it is also important to consider the ramifications if you happen to default. Finance theory is clear that financial decisions involve two central elements, risk and return. This is as true with financing a home as it is in selecting a mutual fund or building an investment portfolio. Therefore, assessing the current "affordability" of mortgage options without considering the potential risk of those options can be a costly mistake. Unfortunately, little information is available to home buyers to assist them in assessing the risk of default of various types of home loans.

To assist home buyers in understanding the default risks of various types of home loans, we document the relative credit risks of five types of mortgage products. We find that, significant risk differences exist among competing products which suggests that homebuyers and homeowners should consider the default risks of these products when selecting a loan to finance or refinance their home.

References

Ambrose, B., & LaCoure-Little, M. (2001). Prepayment risk in adjustable rate mortgages subject to initial year discounts: Some new evidence. *Real Estate Economics*, 29, 305-327.

Ambrose, B., LaCoure-Little, M., & Huszar, Z., (2005). A note on hybrid mortgages. *Real Estate Economics*, 33(4), 765-782.

Baek, C., & Bilbeisi, K. (2011). Should home buyers choose a short- or long-term mortgage? *The CPA Journal*, June, 56-61.

Basciano, P., Grayson, J., & Walton, J. (2006). Is a 30-year mortgage preferable to a 15-year mortgage. *Journal of Financial Counseling and Planning*, 17(1), 14-21.

Buist, H., & Yang, T. (1998). Pricing the competing risks of mortgage default and prepayment in metropolitan economies. *Managerial Finance*, 28(9/10), 110-128.

Calhoun, C., & Deng, Y. (2002). A dynamic analysis of fixed- and adjustable-rate mortgage terminations. *Journal of Real Estate Finance and Economics*, 24(½), 9-23.

Campbell, J., & Cocco, J. (2003). Household risk management and optimal mortgage choice. National Bureau of Economic Research, Inc. *NBER Working Paper: 9759.*

Cox, J., Ingersol, J. Jr., & Ross, S. (1985). An intertemporal general equilibrium model of asset prices. *Econometrica*, 53(2), 363-384.

Cunningham, D., & Capone, C. (1990). The relative termination experience of adjustable to fixed-rate mortgages. *Journal of Finance*, 45(5), 1687-1703.

Dhillon, U., Shilling, J., & Srimans, C. (1987). Choosing between fixed and adjustable rate mortgages: A note. *Journal of Money, Credit, and Banking*, 19(1), 259-267.

Dhillon, U., Shilling, J., & Srimans, C. (1990). The mortgage maturity decision: The choice between 15-year and 30-year FRMs. *Southern Economic Journal*, 56(4), 1103-1116.

Elmer, P., & Seelip, S. (1999). Insolvency, trigger events, and consumer risk posture in the theory of single-family mortgage default. *Journal of Housing Research*, 10(1), 1–25.

Follain, J. (1990). Mortgage choices. *Journal of the American Real Estate and Urban Economics Association*, 18(2), 125-144.

Goff, D., & Cox, D. (1998). 15-year versus 30-year mortgages: Which is the better option? *Journal of Financial Planning*, 11(2), 88-95.

Herman, G., & Lloyd, J. (1995). A home for your family choosing the best mortgage. *North Carolina Extension Service, North Carolina State University College of Agriculture and Life Sciences*, July.

Janjigian, V. (1994). Choosing the term on a fixed-rate home mortgage: a cash flow perspective. *Financial Practice and Education*, Spring/Summer, 167-168.

Kistner, W. (1998). Home mortgage loan term options. *Healthcare Financial Management*, October, 86-88.

Kistner, W. (2001). Choosing the right mortgage. *Healthcare Financial Management*, November, 80-81.

LaCoure-Little, M., & Yang, J. (2010). Pay me now or pay me later: alternative mortgage products and the mortgage crises. *Real Estate Economics,* 38(4), 687-732.

Lee, J., & Hogarth, J. (2000). Consumer information search for home mortgages: Who, what, how much, and what else? *Financial Services Review*, 9, 277-293.

Miles, D. (2004). The UK mortgage market: Final report and recommendations. Imperial College of London (Report Submitted to Chancellor of Treasury).

Miles, D. (2005). Incentives information and efficiency in the UK mortgage market. *The Economic Journal*, 115, c82-c98.

Miles, D., & Pillonca, V. (2007). Housing: Europe vs. the US – sustainability and prospects. MorganSanley, Berlin, 20 September.

Phillips, R., Rosenblatt, E., & Vanderhoff, J. (1992). The effect of relative pricing on the fixed-rate mortgage term decision. *Journal of Real Estate Research*, 7(2), 187-194.

Stanton, R., & Wallace, N. (1995). ARM wrestling: Valuing adjustable rate mortgages indexed to the eleventh district cost of funds. *Real Estate Economics*, 23(3), 311-345.

Tomlinson, J. (2002). Advising investment clients about mortgage debt. *Journal of Financial Planning*, 15(6), 100-108.

Wyman, M. (2005). Risk and funding in european residential mortgage – responding to changes in mortgage demand. Mortgage Insurance Trade Association.

Vickery, J. (2007). Interest rates and consumer choice in the residential mortgage market: A summary. Proceedings, Federal Reserve Bank of Chicago, 326-335.

Vruwink, D., & Gisher, D. (1995). The effects of income tax rates and interest rates in choosing between 15- and 30-year mortgages. *The CPA Journal*, November, 72-75.

Yang, T. (1992). Self selection in the fixed-rate-mortgage market. *Journal of the American Real Estate and Urban Economics Association*, 20(3), 359-391.

Yang, T., Buist, H., & Megbolugbe, I. (1998). An analysis of ex-ante probabilities of mortgage prepayment and default. *Real Estate Economics*, 26(4), 651-676.

Yang, T., Lin, C., & Cho, M. (2011). Collateral risk in residential mortgage defaults. *Journal of Real Estate Finance Economics*, 42(2), 115-142.

ENDNOTES

[1] The research support from the National Science Council of Taiwan (NSC102-2410-H-007-046 for C. C. Lin) is gratefully acknowledged. All errors are our own.

[2] Those to have estimated interest rate parameters over the past few years include Buist and Yang (1998). Of course, 30-year government bond yields have fallen and current long-term interest rates have fallen to between 3.5% and 4%. However, currently r_0 may have reached as low as 1%. Moreover, when we expect that r_0, μ_r simultaneously drop, it follows that the FRM's contract rate will also be set lower. When monitoring U.S. interest rate trends, it appears that only long-term interest rates are falling, so $\alpha = 0.25, \sigma_r = 0.15$ is also probable. Therefore, we believe that the interest rate parameters are suitable.

[3] With regard to housing price fluctuations, Yang, Lin and Cho (2011), report that in the U.S., from 1991-2010, annual house prices grew at an average rate of 3.3%. With regard to σ_{H_2}, as no individual house price data set exists, only estimated data can be used. Often, σ_{H_2} will reflect individual home repairs, for example, building and decorating and other factors that may lead to discrepancies. If the sample is expanded, for example, if h_1 were to be the state housing price growth rate, σ_{H_2} should also reflect the state's urban-rural gap caused by the deviation of the individual housing price growth rate from the state housing price growth rate. In certain counties, the annual housing price growth rate has almost reached 30%, in others, housing prices have virtually stagnated. As a result, σ_{H_2} is thought to be greater than σ_{H_1}, therefore it follows that $\sigma_{h_1} = 0.06, \sigma_{h_2} = 0.08, \sigma_H^2 = 0.06^2 + 0.08^2 = 0.1^2$ representing that 36% ($\frac{\sigma_{H_1}^2}{\sigma_{H_1}^2 + \sigma_{H_2}^2}$) of housing price variations originate from systematic factors, and 64% come from individual factors, which is expected. With regard to income growth, U.S. economic growth over the past 10 years has averaged around 3%. The calculated average income growth rate is 3.5%, not far from the above rate. Of course, income growth rate variations from individual factors should be greater, and therefore σ_{y_1}, σ_{y_2} and $\frac{\sigma_{Y_1}^2}{\sigma_{Y_1}^2 + \sigma_{Y_2}^2} \approx \frac{1}{3}$ is also considered appropriate. As for the setting of the correlation coefficient, with an overheated housing market or economy, the U.S. Federal Reserve will likely raise interest rates to curb inflation. Therefore, it is reasonable to set the correlation coefficient to 0.6 to 0.7. The growth rate H_2 and Y_2 should be positively correlated, and furthermore a single correlation coefficient should not be high.