Asian Journal of Economics and Finance. **2019**, 1, 1-2

ARF INDIA
Academic Open Access Publishing
www.arfjournals.com

Analyzing the Dynamics of ARM, FRM & Hybrid Mortgage Loans

Dan Han[1] and Howard Qi[2*]

[1] *University of Louisville*
[2*] *Michigan Technological University (contact author : howardqi@mtu.edu)*
Received: 21 July 2018; Revised: 12 September 2018; Accepted 27 November 2018; Publication: 5 May 2019

Abstract: In real estate finance, it is widely understood that the mortgage rates on the ARM, FRM and hybrid loans are normally different and reflecting different exposure to interest rate risk. Specifically, the buyer bears the entire interest rate risk in ARM loans, none in FRM loans, and partially in hybrid loans. This notion predicts an ARM rate lower than the FRM rate with the teaser rate on the hybrid loans in-between. However, this is fallacious. We analyze this fallacy and make predictions with supporting empirical evidence. Our study sheds new light on real estate finance, and financial risk management.

Keywords: mortgage, adjustable rate, fixed rate, risk allocation

JEL classification: G00, G12, G21

I. Introduction

In the mortgage loan lending industry, there are different types of products created for the borrowers. Among the common ones, are the fixed-rate mortgage (FRM), adjustable-rate mortgage (ARM), and hybrid mortgage loans. Throughout history, many other types have been offered to the market as well such as the graduated payment mortgage (GPM), pledged-account mortgage or flexible loan insurance program (FLIP), balloon payment note, shared appreciation mortgage (SAM), share equity mortgage (SEM), reverse annuity mortgage (RAM), etc.

Nowadays, the dominant types are the FRM, ARM, and hybrid. The hybrid type is also often referred to as ARM or M/N ARM where M is the first M years with fixed rate and N is the adjustment period. For example, 3/2 ARM allows the borrower to enjoy the fixed rate, also called the teaser rate, for the first 3 years, and the rate becomes adjustable against some benchmark rate every two years afterwards. Typically an M/N ARM has a term of 30 years unless specified otherwise. Sometimes, a 3/1 ARM may be advertised as 3/27 ARM, or a 5/1 ARM as a 5/25 ARM, with the second number (27 and 25) to denote the remaining years of amortization with annual rate adjustment. These notational variations can be easily discerned appropriately in the given context. We follow the popular industry convention to use 5/1 ARM rather than 5/25 ARM to refer to a 30-year (hybrid) ARM loan with a fixed teaser rate for the first 5 years.

In this study, we focus on the relationship between the FRM and ARM rates, and the hybrid ARM's teaser rate in particular. In doing so, we first briefly review the mortgage market, products, and their historical and geographical

developments. Then we analyze some mainstream yet questionable understandings in this regard and present our alternative theory supported by empirical evidence. Specifically, by posing the *paradox of risk sharing*, we question the validity of the conventional wisdom which we referred to as *the risk shift theory*. Then we further advance the theoretical front by proposing a new theory for the FRM-ARM spreads with empirical support, which we call the *incentivizer theory of ARM*.

Readers can go directly to section 2.2. for the main contributions of this study. Finally, throughout this study, as is commonly so in the lending industry, we may use ARM to refer to both ARM and hybrid ARM.

1.1. A Global Review of the FRM and ARM Loans

The development of the FRM and ARM products took very different routes in the U.S. than in other countries. ARMs have had a much longer history outside the United States. For example, British mortgage lenders have offered ARMs since 1932. Canada has developed a renewal type of note known as the Canadian Rollover (See Wiedemer and Baker, 2013). Australia, Ireland, Korea, Spain and the U.K. are dominated by ARMs which are often known as variable rate mortgage (VRM) outside the U.S. According to Lea (2010), the teaser rates in Australia and the U.K. usually last one to two years. In Canada, Denmark, Germany, the Netherlands and Switzerland, short- to medium-term FRMs are dominant. The reason why traditional lenders predominantly preferred ARMs or short-term FRMs may be easily understood from the risk management perspective of duration matching given that most mortgage originators are depository lenders.

1.2. The U.S. Mortgage Market and the FRM and ARM Loans

In sharp contrast, the U.S. is the only country where long-term fixed-rate mortgage loans completely dominate the market for a long time. This has to do with the fact that until 1982, federally insured depository institutions were restricted to long-term fixed rate equal payment mortgages. ARMs were legalized to help financial institutions weather rising and volatile interest rates and keep away from insolvency (see for example, Arsham, 2007). The first ARM design was approved by the Federal Home Loan Bank Board in 1979 and the maximum interest rate changes were limited to 0.5% per year and not more than 2.5% over the life of the loan. These strict caps essentially made the ARM more like a FRM particularly in a time when the interest rates were very high and volatile. Another major regulation amendment (for Regulation Z) aiming at borrower protection came as late as Oct. 1, 1988 (Wiedemer and Baker, 2013). It calls for lenders to provide more extensive information to consumers on the characteristics of ARMs.

The popularity of *hybrid* ARMs in the U.S. has significantly increased in recent years. For example, in 1998 the ratio of hybrids to 30-year FRMs was still less than 2%; but within six years, this increased to 27.5% (see, Fabozzi

2006). Nevertheless, Pennington-Cross and Ho (2006) report the termination of subprime hybrid and a sharp drop in hybrid in general because of the subprime mortgage crisis. However, the hybrid ARMs have regained substantial popularity in recent years according to Freddie Mac. We note that ARMs in general have evolved differently. For example, Moench et al (2010) point out that ARM share peaked between 60% and 70% in 1994 but fell significantly afterwards. Arsham (2007) claims that in 2005, 26% of all home loans were interest-only and 15 percent were ARMs, while Ambrose et al (2005) quote a research report by Mortgage Bankers Association in 2004 that ARMs accounted for 39% of all mortgage originations due to the financial deregulation of the 1980s. However, they note that the majority of ARMs concentrated in the jumbo market rather than the conforming loan segment, accounting for as high as 72% of total originations during 1994 and 2000. Considering much higher dollar amount per loan in the jumbo market, the ARM share in the (mainstream) conforming segment should not be far off from the numbers given by Fabozzi (2006). Our study will focus on the *hybrid* ARM type which is now commonly referred to as ARM.

ARMs' popularity has not been uniform in the U.S. either. They have been more popular in some parts of the U.S. due to different housing costs. For example, California, Florida, and coastal areas in general have had higher levels of ARM origination (See Di Maggio et al 2014).

Normally, ARM loans have eight or nine terms that need to be specified when the loan is originated. By adjusting them, lenders could conceive essentially unlimited combinations of ARM terms. However, the mortgage market in the U.S. has gradually evolved to favor only a few different types. According to Clauretie and Sirmans (2010), nowadays the most popular type (X/1) is the 1-year adjustable tied to a 1-year Treasury index with the fixed teaser rate for the first X years. According to Freddie Mac's blog of January 26, 2015, "*the 5/1 hybrid, a five-year fixed-rate initial period before the rate resets annually, was by far the most common, followed by the 7/1, 3/1 and 10/1, Freddie said. Far less popular among the survey participants are ARMs where the repricing frequency is fixed for the life of the loan, such as a one-year adjustable; a 3/3 ARM, which adjusts once every three years; or a 5/5 ARM, which adjusts every fifth year*." Given this situation, in this study, we focus on the 5/1 ARMs and FRMs. The conclusions are general enough to be applicable to other ARMs such as 2/1, 3/1, etc.

We expect the (hybrid) ARM market to continue to evolve and likely expand. For example, a recent paper by Campbell (2012) studies the causes and consequences of cross-country variation in mortgage market structure and argues that the U.S. still has much to learn from other countries. How the U.S. mortgage market would evolve has a lot to do with legal regulations. Bostic et al (2012) provide evidence of some new anti-predatory lending laws shaping the mortgage products. Thus, the U.S. mortgage is a continuously evolving arena.

II. Current Understanding and Criticism

2.1. The Demand for ARM Loans

It is believed that the demand for ARMs is primarily affected by two factors, see for example Clauretie and Sirmans (2010, p. 105). The first is the market interest rates in general. The second is the spread between the prices of (or rates on) FRMs and ARMs. While these claims may have merits and validity, we feel some important caveats are warranted against these generalizations especially for the U.S. market.

First, there are other important factors that are worth pointing out. Mori et al (2009) point out that a considerable number of borrowers still choose ARMs over FRMs even when interest rates are historically very low. They conducted experiments to show that behavioral explanation based on the prospect theory can have a significant explanatory power beyond the rates and spreads. Gurun *et al* (2013) document considerable marketing effect on less sophisticated consumers. Bergstresser and Beshears (2010) document that less suspicious households who have difficulty understanding complicated ARM features took disproportionately ARMs. Taken together, these studies also strongly indicate that the ARM market is mostly driven by the supply side. MacDonald and Winston-Geideman (2012) explores inflation's influence.

Second, as we showed earlier, the popularity or ARMs in recent years has to do largely with the policies and de-regulations. In fact, since the late 1970s, borrowing rates have consistently gone down significantly. Figure 1 clearly shows various relevant interest rates from 1982 to 2015. When the borrowing rate is low, ceteris paribus, lenders have less incentive to promote long-term FRMs, and a stronger incentive to lure borrowers into taking out ARMs. It may appear to be able to explain the increasing popularity of ARMs, but this trend of incentive is the opposite when we look at the issue from borrowers' perspective for obvious reasons. Therefore, the popularity of ARMs has to do with the relative bargaining power of the lenders and borrowers. In other words, ARMs' popularity can happen at any levels of interest rates. As Figure 1 shows that major regulation changes were made as the interest rates were going down which paved the way for ARMs to boom in a regime where we have historically low interest rates. There is no reason to believe that if the rates rise in the future into a high-rate regime like the late 1970s and early 1980s ARMs would become less popular.

- *Contract rate:* national average contract mortgage rate reported by a sample of mortgage lenders for loans closed during the last 5 working days of the month. The rate is based on conventional fixed and adjustable-rate mortgages on previously occupied non-farm single-family homes.

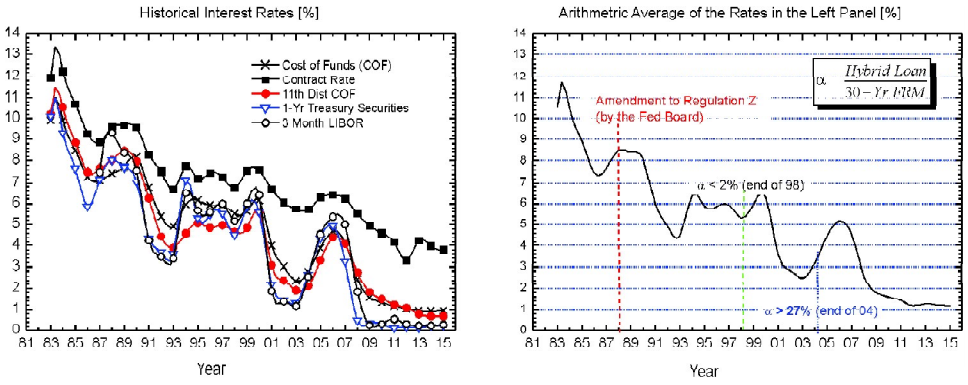

Figure 1: **Historical interest rates**. In the left panel, five types of rates are shown. In the right panel, we show the equal-weighted arithmetic average of these five rates. The rates have clearly declined significantly from the early 80's to the present time. In particular, the average rate was almost 12% in 1984 when ARM loans were extremely rare; in 1998, it was about 5% when ARMs/30-yr FRMs ratio was less than 2 percent of the mortgage market in terms of dollar amount; and at the end of 2004 it was about 3% when ARMs/30-yr FRMs ratio exceeded 27 percent market share; and it was around 1% in 2015. Therefore, ARMs' popularity happened to occur in a low interest rate domain due to a variety of reasons such as the US housing market and mortgage industry convention and government regulations, etc. Source: Wiedemer and Baker (2013, p.127) for 1983 to 1991, and *http://mortgage-x.com/general/indexes/* for 1992 to 2015, reproduced with the permission of Mortgage-X.com. Figures are as of December of each year (except for 2015 where July is used).

- *Cost of funds (COF):* the federal cost of funds index is calculated as the sum of the monthly average interest rates for marketable Treasury bills and for marketable Treasury notes, divided by two.
- *11th District COF:* this index reflects the weighted-average interest rate paid by 11th Federal Home Loan Bank District savings institutions for savings and checking accounts, advances from the FHLB, and other sources of funds.

Third, Arsham (2007) notes that ARMs have increasingly used by consumers to qualify for large loans rather than to take advantage of interest rate trends. Shortly before the subprime mortgage crisis, the interest rates were not high, yet ARMs were increasing fast, and lenders refer to them as affordability products when high home prices were high. Therefore, the size and activeness of the jumbo loan market appear to have a significant impact on the share of ARMs apart from the FRM and ARM rates and their spreads in the mainstream conforming mortgage segment.

2.2. The Risk Shift Theory of FRM-ARM Spreads and the Paradox of Risk Sharing

In this study, we restrict "risk" to interest rate fluctuation, i.e., *interest rate risk*. Other important risks associated with mortgage loans are the default risk and

modeling risk. For interested readers, we refer them to Mayer et al (2008) for rise in mortgage defaults during the financial crisis, Chan et al (2011) for neighborhood characteristics in default risk, Demyanyk and Hemert (2008) for understanding the subprime mortgage crisis, and Fishbein and Woodall (2006) for non-traditional mortgage products and the payment shock for ARM borrowers when the payment reset started in 2006. Rajan et al (2009) offer a soul-searching discussion on the theoretical and modeling front in reflection on the subprime mortgage crisis.

Surveying vast volume of literature, we find that it is the conventional wisdom and widely held belief that the ARM rates should be lower than the FRM rates. The reason is that ARMs expose borrowers to interest rate fluctuations hence make them bear more risk, therefore borrowers receive a reduction in rate as a compensation for "sharing the risk." We refer to this argument as the risk shift theory for mortgage rates and the FRM-ARM spreads. In this section, we first document some typical such understanding in research papers and mainstream textbooks. Then at the end of this section, we question this "risk shift theory" by highlighting a paradox.

Among many research papers, for example, Manchester (1984) argues that "*the ARM is one innovation introduced by lenders to reduce the risk they must bear in making mortgage loans. But many borrowers find the risks of fluctuating payment levels difficult to accept*." Arsham (2007) in discussing the development of ARMs claims "*Clearly these (ARM) borrowers are looking for a way to solve the tilt problem. However, they are now facing interest rate risk.*" Similarly, Mori et al (2009) also view the FRM-ARM dynamics as interest risk sharing between the mortgagor and mortgagee. Popular textbooks such as Wiedemer and Baker (2013), Clauretie and Sirmans (2010), Brueggema and Fisher (2010), etc. advocate the similar understanding. For example, Clauretie and Sirmans (2010, p. 104) state

> "*The rate of interest on an ARM is typically 1 to 3 percentage points below that on a fixed-rate loan. The reason is simple. Lenders accept a lower rate for shifting a portion of the interest rate risk to borrowers. The more risk they can shift to borrowers through loose caps and frequent adjustment periods, the lower will be the rate relative to that on a fixed-rate loan.*"

Nevertheless, Clauretie and Sirmans (2010) acknowledge that when the yield curve is downward sloping, the FRM-ARM spread has nearly disappeared, but they emphasize that the spread will never be zero or even negative and claim that "*Generally, borrowers can expect to get a 1 to 3 percent break on the ARM rate over the FRM rate*."

It is fair to say that this risk shift theory for mortgage rates and spreads has been widely accepted in research literature and academia. However, a careful examination of its logic raises serious doubt. We formally present this analysis and term it "the Paradox of Risk Sharing." In a mortgage loan contract, there are two parties, the mortgagor or borrower and the mortgagee or lender. The

mortgage rate specifies the cash outflows for the borrower as well as the cash inflows for the lender. The two cash flows are always identical in value and opposite in sign. Therefore, the fluctuation in the mortgage rate is identically impacting both parties. Using the concurrent FRM loan as the reference, an ARM loan would expose both sides to the same amount of interest rate fluctuation. If the switch from the FRM to an ARM loan shift certain amount of interest rate risk to the borrower, the same holds true for the lender. If more interest rate risk is shifted to the borrower and therefore the rate on ARM should be lower as argued in the conventional wisdom, the same argument can be used to argue for a *higher* ARM rate because it makes the lender bear more interest rate risk (compared to the FRM loan). Indeed, the federal regulation, as a result of appeals by the mortgage lending industry, has preempted most state laws prohibiting penalty on prepaying mortgage loans. This is direct evidence that lenders do require a compensation for bearing higher interest rate risk due to borrowers' stopping the FRM loan sooner and subjecting the lenders to uncertain interest income from new loans they will have to lend after the borrowers close the loan before maturity. To sum up, going from FRM to ARM loan, both the borrower and the lender are exposed to higher interest rate risk. Therefore, the risk shift theory can be used to argue *for* and *against* a positive FRM-ARM spread simultaneously. We reveal this intrinsic contradiction and refer to it as the *Paradox of Risk Sharing*.

In addition to this paradox, we will show later that in general the ARM rates are lower than the FRM rates as the traditional wisdom claims, however, we also document cases where the ARM rates are higher than the FRM rates. What contradicts the traditional wisdom even more is that the negative FRM-ARM spreads occurred in a time when the yield curve is not inverted.

A final criticism we may make is that although the argument by the traditional risk shift theory seems to agree with what we normally observe, we note that the ARMs only became popular (hence the availability of data) since late 1990s and interest rates were already in a low-rate regime. Interest rates have maintained a largely continuous decline till the present time (2016) due to various market conditions and government monetary policies (see Figure 1). In other words, the traditional wisdom has never been put to test in a high-rate environment. In the end, the traditional wisdom does not have much to say about the FRM-ARM spreads. We note that Clauretie and Sirmans (2010) indeed point out that the spreads may narrow or even disappear when interest rates are high, but they rule out that (1) the spreads can narrow when interest rates are historically low; and (2) the spreads can even be negative. As we will show later, all these points from the traditional wisdom and understandings are violated in some cases. It would be interesting to ask, whether the traditional theory would behave even more poorly if we enter into a high-interest regime; and whether we have a better theory to handle these legitimate concerns.

Next, we present a new theory that we call the Incentivizer Theory of ARM and apply this theory to the actual mortgage data. We have obtained remarkable results that agree with the predictions by this new theory but completely unexplainable by the traditional risk shift theory. In addition to this theory success, we further reveal more intrinsic dynamics in how ARM rates are determined and further predictions we may draw for future eras when interest rates rise significantly. We note that due to regulatory and conventional limitations, ARMs have not been widely available in high interest periods and no theory (see Figure 1), to our knowledge, addresses the FRM-ARM spreads when interest rates become very high. Therefore, it is particularly interesting to see how ARM rates would vary when the rates rise significantly, which can be nicely addressed by the new theory we propose.

III. The Incentivizer theory of ARM and the Model

Even though various attempts have been made to better understand ARM rates, thus far there are not many theories in this regard. Among them, Berk and Roll (1988) provide a simulation model based on the choice of the ARM indexes. Kau et al (1990) introduce a model with one single auxiliary state variable to handle prominent features of ARMs including teasers. Prompted by the paradox of risk sharing mentioned earlier, we take a different approach by looking at the dynamics of the ARM (teaser) rates in a holistic perspective as follows.

(1) The ARM market is largely driven by lenders, which is a foundation for the rest of the theory

(2) Lenders, affected by various macroeconomic factors, use teaser rate as an incentivizer to guide borrowers into favoring ARMs or FRMs

(3) The strength of this incentive is manifested (and measured) against the backdrop of FRM rates because teaser rate (hence spreads) is intended to be used in comparison with them

There are several direct implications or predictions to make based on this understanding.

First, teaser rate on ARMs is different from the spot 1-year ARM rate. This is a trivial but important point because teaser rate takes on the role of incentive rather than reflecting the market 1-year rate which tends to be random. Second, ARM and FRM rates tend to move in the same direction, i.e., they tend to have positive correlation. This is because in most cases, term structure of interest rates is upward sloping. Third, the FRM-ARM spreads may be positive as well as negative, depending on whether the incentive is to attract borrowers to ARM or FRM and the extent of such incentive. Fourth, when interest rates are high, lenders make greater effort to keep borrowers in FRMs by using relatively high teaser rates as a disincentive to taking ARMs. It is vice versa when interest rates are low. We can measure this relative strength of incentive by

$$RS = \frac{S}{R_{FRM}} = \frac{R_{FRM} - R_{ARM}}{R_{FRM}} \tag{1}$$

Where RS is the relative spread, S is the FRM-ARM spread, R_{FRM} is FRM rate, and R_{ARM} is teaser rate on (hybrid) ARM. The fourth implication hinges on an assumption – interest rates are random and mean-reverting. We note this assumption's validity is supported by a great amount of empirical evidence. It basically says that when we are in a very high rate regime (such as in 1980), interest rates are more likely to go down in the future, and vice versa for low rate regime. In other words, the higher the rates above (below) the mean, the greater the expectation for them to decrease (increase).

For simplicity, we use a linear equation to model the incentivizer theory of ARM,

$$RS = R_{FRM} \times B + A \tag{2}$$

Based on the above analysis, the incentivizer theory of ARM would predict a positive correlation between R_{FRM} and R_{ARM} over time t,

$$COV\left[R_{FRM}(t),\ R_{ARM}(t)\right] > 0 \ \text{ or } COV\left[\Delta R_{FRM}(t),\ \Delta R_{ARM}(t)\right] > 0 \tag{3}$$

It also predicts the following inequalities for the slope and intercept,

$$A > 0 \ \text{and} \ B < 0 \tag{4}$$

and negative correlation between the relative spread and FRM rate,

$$COV\left[RS(t),\ R_{FRM}(t)\right] < 0 \tag{5}$$

IV. Analysis and Discussion

4.1. Theoretical Predictions and Empirical Results

The first point of the incentivizer theory of ARM claims that the ARM market is largely driven by lenders. This is a subtle yet important point because otherwise it would be hard to establish an argument for lenders to play an active role (manifested in the teaser rate's role of an incentivizer). Earlier we have quoted research by Mori *et al.* (2009) on behavioral explanation, Gurun *et al.* (2013) on marketing effect on less sophisticated consumers, and Bergstresser and Beshears (2010) on households having difficulty understanding ARM features and taking disproportionately ARMs. They strongly support the notion of the lender-driven ARM market.

Figure 2 exhibits rate on 1/1 ARM (a pure ARM) versus rate on 30-year FRM. The right panel shows a positive correlation between ARM rate and FRM rate, as predicted by the incentivizer theory. But the right panel shows a completely random (to the eye) pattern between 1/1 ARM rate and FRM rate. This is actually not against our theory because 1/1 ARM rate is the spot market

rate, not teaser rate. It is what our theory predicts (see the first implication above).

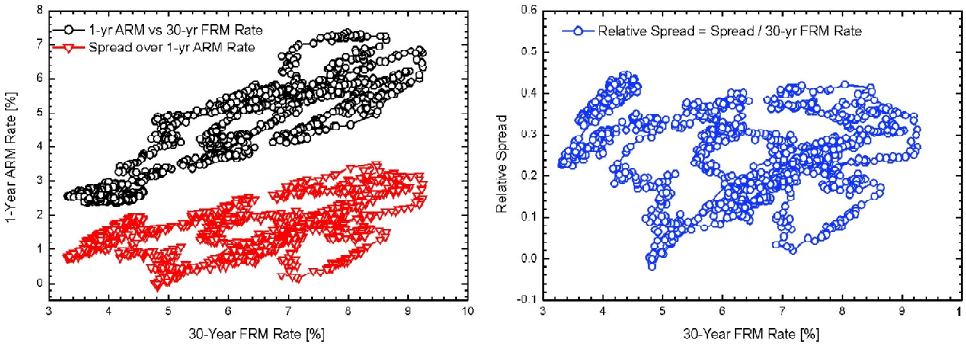

Figure 2: **Historical mortgage rates: 30-Yr FRM versus 1-Yr ARM**. In the left panel, the line with empty circles denotes concurrent weekly observations of 1-yr ARM and 30-yr FRM rates from February 7, 1992 to July 17, 2015. The line with downward open triangles denotes the spread of 30-yr FRM rate over 1-yr ARM rate for the same data set. In the right panel, we show the relative spread defined as the ratio of the spread to the corresponding 30-yr FRM rate. Notice that the data show an overall positive correlation in the left panel and virtually rather random in the right panel. Reproduced with the permission of Mortgage-X.com.

Figure 3 shows monthly rates on 15-year FRM, 30-year FRM, and 5/1 ARM loans from January, 2005 to December, 2015. In the left panel, we also show the FRM-ARM spreads indicated by open triangles and solid circles at the bottom. In the right panel, we show the relative spreads, *RS* defined in equation (1).

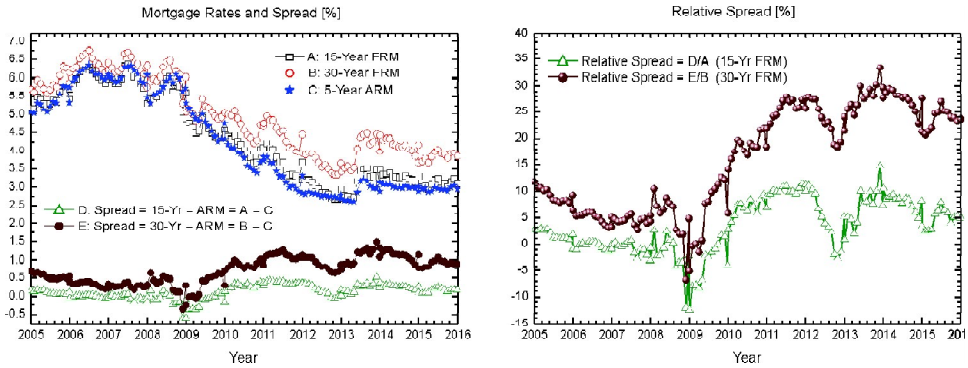

Figure 3: **Historical mortgage rates: 15- and 30-Yr FRM versus 5/1 ARM (or hybrid)**. In the left panel, the upper three time series represent the 15- and 30-yr FRM rates and the teaser rate on the concurrent 5/1 ARM (or hybrid) loans. The lower two time series represent the spread of the FRM rates over the 5/1 ARM teaser rate. In the right panel, the two time series are the relative FRM-ARM spreads defined as the ratio of the rate differential between FRM and ARM as a percentage of the FRM rate. Source: Freddie Mac.

First, as shown in the left panel, both the FRM and ARM rates (shown by the three upper curves) tend to move in the same direction as the trivial prediction we made

$$COV\left[R_{FRM}(t),\ R_{ARM}(t)\right] > 0 \ \text{ or } COV\left[\Delta R_{FRM}(t),\ \Delta R_{ARM}(t)\right] > 0 \qquad (3)$$

Second, we note that $RS > 0$ for most of the time, in line with the conventional wisdom, but there are cases where $RS < 0$, for example, around 2008 right after the subprime loan crisis, which is against the conventional wisdom ($RS = R_{FRM} - R_{ARM} \geq 0$) explained earlier. What makes it even worse for the conventional wisdom is that $RS < 0$ happened in a low-interest period (see Figure 1). According to Clauretie and Sirmans (2010), "*the spreads may narrow or even disappear when interest rates are high*." This conventional wisdom may have its merits in that spreads in general slightly decline as interest rates rise albeit quite flat, and it is neither necessarily nor sufficiently true as shown by the data (indicated by "$RS < 0$" parts of the data).

On the other hand, the incentivizer theory can easily explain the data – despite the overall low interest rates right after the subprime mortgage crisis, lenders wanted to limit or even terminate their offerings of ARMs especially the jumbo loans. They did so by increasing teaser rates until the goal is reached and there is no limit to teaser rate.

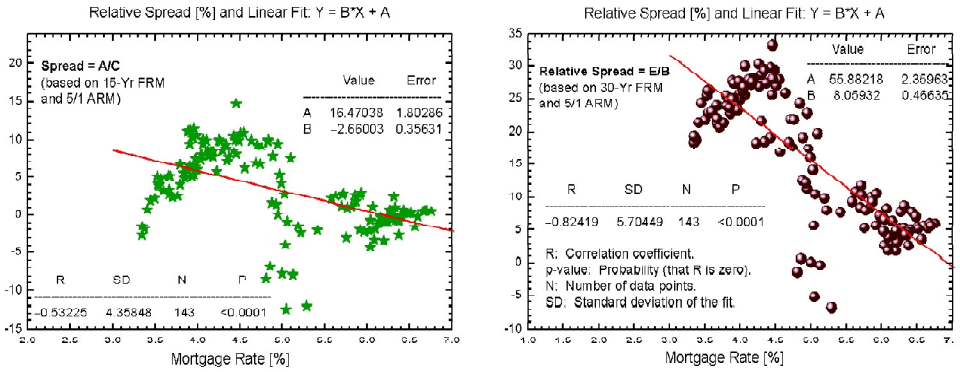

Figure 4: **Relative spread: FRM-ARM rate differential as a percentage of the FRM rates.** In the left panel, the upper three time series represent the 15- and 30-yr FRM rates and the teaser rate on the concurrent 5/1 ARM (or hybrid) loans. The lower two time series represent the spread of the FRM rates over the 5/1 ARM teaser rate. In the right panel, the two time series are the relative FRM-ARM spreads defined as the ratio of the rate differential between FRM and ARM as a percentage of the FRM rate. Compared to the right panel of Figure 2, the relative spreads based on the 5/1 ARM teaser rate clearly demonstrate a negative correlation with the FRM rate while it is random based on the 1-yr ARM rate. This indicates that 1-yr ARM rate and *N*/1 ARM (or hybrid) rate are conceptually different even though they are both normally referred to as the ARM rate. Source: Freddie Mac.

Figure 4 analyzes the relative spreads. In the left panel, we show the spreads between 15-year FRM rate and 5/1 ARM rate versus 5/1 ARM rate. In the right panel, we analyze the same relationship except that we use 30-year FRM. Since 5/1 ARM has the same 30 year maturity, we focus on the right panel.

The incentivizer theory of ARM highlights the teaser rate's incentive role predicting a negative correlation between the relative spread *RS* and FRM rate,

$$COV\left[RS(t),\ R_{FRM}(t)\right] < 0 \tag{5}$$

Results in Figure 4 clearly support this prediction. Furthermore, based on the linear model $RS = R_{FRM} \times B + A$, the results are $A = 56 \pm 2.4 > 0$ and $B = -8.1 \pm 0.5 < 0$. The signs are exactly as the incentivizer theory predicts, i.e., $A > 0$ and $B < 0$. Table 1 summarizes the results from a least square linear fitting of the model by the incentivizer theory given by equation (2).

Table 1: Results from the least square fit of the linear model by the incentivizer theory

A (intercept)	*B (slope)*	*R (correlation coefficient)*	*SD (standard deviation)*	*N (number of observations)*	*P-value*
			5.704	143	< 0.0001

The correlation coefficient $R = -0.824$ describes the trend between $\Delta RS(t)$ and $\Delta R_{FRM}(t)$. A very negative *R* value implies a strong negative correlation as indicated by the downward slope (B < 0). Intuitively, the interpretation is that when FRM rate gets higher, lenders have a stronger desire to lure borrowers into choosing FRM loans by setting a relatively higher ARM teaser rate, and when FRM rates get lower, they have a strong desire to "guide" borrowers into choosing ARM loans by lowering teaser rate.

4.2. Additional Remarks on the Incentivizer Theory of ARM

First, using the relative measure for the FRM-ARM spreads, *RS*, rather than the absolute spreads makes the current incentivizer theory unique. Its advantage is obvious – the negative correlation is clearly manifested ($R = -0.824$), while traditionally using the absolute spreads does not bring out an obvious effect (as shown by the quite flat spreads pattern in Figure 3's left panel).

Second, using the relative spreads makes more sense. This is because the incentivizer theory posits that the teaser rates on ARMs are used to influence borrowers' decision making on choosing between a FRM loan or an ARM loan. Borrowers make direct comparison between the available FRMs and ARMs. Decision makers in general use reference explicitly, or implicitly, which in

psychology is known as the anchoring effect. Using the absolute spreads ignores the underlying decision making process.

Finally, hybrid ARMs are now the dominant ARM type and 5/1 ARMs have evolved to be the most popular type. But hybrid ARMs were less than 2% of 30-yr FRMs in 1998 and about 27% at the end of 2004 (see, Fabozzi 2006), therefore data availability is a problem for earlier years. Indeed, Freddie Mac provides hybrid ARM data only dating back to 2005. This means that our data (on FRM-ARM spreads) are completely for a era when interest rates are historically low. And this is why the traditional wisdom (as in the risk shift theory) can make seemingly correct claims such as ARM rates being normally 1 to 3 percentage points less than FRM rates. We caution the readers that when interest rates rise to high regime such as the late 1970s and early 1980s, the conventional wisdom is expected to behave more incorrectly. In contrast, our incentivizer theory of ARM is poised to make quantitative predictions as to how the ARM teaser rates may react to changing FRM rates through equation (1) in combination with Table I. In particular, we predict negative FRM-ARM spreads are more likely when FRM rates exceed 7% or 8% (see the linear fitting in the right panel of Figure 4).

V. Conclusions

In this study, we first give a brief review of the mortgage lending market, products and their historical and global development. Then we explain the conventional wisdom – the risk shift theory regarding the FRM-ARM spreads and reveal an embedded logical fallacy by posing the paradox of risk sharing (from both the lenders' and borrowers' perspectives).

Then we propose a novel theory regarding the FRM-ARM spreads by positing teaser rates as an incentivizer for lenders to guide borrowers into or out of FRM loans. Using empirical data and a simplified linear model based on this so-called incentivizer theory of ARM, we were able to successfully analyze the FRM/ARM rates dynamics and showed that the results fit with the predictions very well.

Furthermore, we use this new theory to make quantitative predictions about ARM teaser rates if interest rates are high which has yet to happen. This is particularly interesting because all available teaser rate data are for a period when interest rates are historically low. To our humble knowledge, this is the first theoretical model that intends to make such predictions.

References

Ambrose, B. W., M. LaCour-Little, and Z. R. Huszar, 2005, "A Note on Hybrid Mortgages", *Real Estate Economics* 33 (4), 765-782.

Arsham, H., 2007, "The Rate Decision: Adjustable vs Fixed Rate Mortgages", *Journal of Business and Economics Research* 5 (11), 31-42.

Bergstresser, D., and J. Beshears, 2010, "Who Selected Adjustable-Rate Mortgages? Evidence from the 1989-2007 Surveys of Consumer Finances", Harvard Business School Working Paper 10-083.

Berk, J., and R. Richard, 1988, "Adjustable Rate Mortgages: Valuation", *Journal of Real Estate Finance and Economics* 1, 163-184.

Bostic, R. W., S. Chomsisengphet, K. C. Engel, P. A. McCoy, A. Pennington-Cross, and S. Wachter, 2012, "Mortgage Product Substitutions and State Anti-Predatory Lending Laws: Better Loans and Better Borrowers?", Atlantic Economic Journal 40 (3), 273-294.

Brueggeman, W., and J. Fisher, 2010, *Real Estate Finance and Investment*, 14th Edition, McGraw-Hill Education, New York.

Campbell, J. Y., 2013, "Mortgage Market Design", *Review of Finance* 17 (1), 1-33.

Chan, S., M. Gedal, V. Been, and A. Haughwout, 2011, "The Role of Neighborhood Characteristics in Mortgage Default Risk: Evidence from New York City", NYU Working Paper.

Clauretie, T. M, and G. S. Sirmans, 2010, Real Estate Finance, Theory & Practice, 6th Edition, CENGAGE Learning.

Demyanyk, Y., and O. van Hemert, 2008, "Understanding the Subprime Mortgage Crisis", *Review of Financial Studies* 24 (6), 1848-1880.

Di Maggio, A. Kermani, and R. Ramcharan, 2014, "Monetary Policy Pass-Through: Household Consumption and Voluntary Deleveraging", Columbia Business School Research Paper, no. 14-24.

Fabozzi, F. J. (ed), 2006, *Handbook of Mortgage-Backed Securities*, 6th Edition, McGraw-Hill Education, 259–260.

Fishbein, A. J., and P. Woodall, 2006, "Exotic or Toxic? An Examination of the Non-Traditional Mortgage Market for Consumers and Lenders", report, Consumer Federation of America, Washington, D.C.

Gurun, U. G., G. Matvos, and A. Seru, 2013, "Advertising Expensive Mortgages", Fama-Miller Working Paper; Kreisman Working Papers Series in Housing Law and Policy No. 10. Available at SSRN: *http://ssrn.com/abstract=2233380*

Kau, J. B., D. C. Keenan, W. J. Muller, and J. F. Epperson, 1990, The Valuation and Analysis of Adjustable Rate Mortgages, *Management Science* 36 (12), 1417-1431.

Lea, M., 2010, "International Comparison of Mortgage Product Offerings", special report, Research Institute for Housing America, and Corky McMillin Center for Real Estate at the San Diego State University.

MacDonald, D. N., and K. Winson-Geideman, 2012, "Residential Mortgage Selection, Inflation Uncertainty, and Real Payment Tilt", *Journal of Real Estate Research* 34 (1), 51-72.

Manchester, J., 1984, Mortgage Finance: Why Not PLAM's?, *Economic Review*, September-October, 31-44.

Mayer, C. J., K. M. Ponce, and S. M. Sherlund, 2008, "The Rise in Mortgage Defaults", Finance and Economics Discussion Series Divisions of Research & Statistics and Monetary Affairs, Federal Reserve Board, Washington, D.C.

Moench, E., J. Vickery, and D. Aragon, 2010, "Why Is the Market Share of Adjustable-Rate Mortgages So Low?", Federal Reserve Banks of New York, *Current Issues in Economics and Finance* 16 (8), 1-11.

Mori, M., 2009, "Why Do Borrowers Choose Adjustable-Rate Mortgages over Fixed-Rate Mortgages?: A Behavioral Investigation", *International Real Estate Review* 12 (2), 98-120.

Pennington-Cross, A., and G. Ho, 2006, "The Termination of Subprime Hybrid and Fixed Rate Mortgages", working paper 2006-042A, Research Division, the Federal Reserve Bank of St. Louis.

Rajan, U., A. Seru, and V. Vig, 2010, "The Failure of Models That Predict Failure: Distance, Incentives and Defaults", Chicago GSB Research Paper No. 08-19; EFA 2009 Bergen Meetings Paper; Ross School of Business Paper No. 1122. Available at SSRN: *http://ssrn.com/abstract=1296982*

Wiedemer, J. P., and J. K. Baker, 2013, *Real Estate Finance*, 9th Edition, CENGAGE Learning.