A Mortgage Backed Securities Pricing Model and Its Implication of Trading Strategy

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ABSTRACT

Mortgage-backed security (MBS) is a capital market innovation that gained popular acceptance in the 1980s and are even stronger in the 1990s in the states. In Taiwan since 2000 tech bubbles busted, stock market sunk, investors tended to invest their money into bond market that represents the features of having stable return than equity market. MBS as an instrument has the same credit rating as US treasury but get higher returns, become popular in the market. Since 2003 the US interest rate hit historical low level, said 1% through 2004 to now MBS attract lots of money to invest in. However, even in the states, MBS having longer history than in other countries, the pricing is still subject to uncertainty due to the existence of the mortgage prepayment option. This study describes the options-based model that can be used to price MBS and details possible prepayment functions that can be incorporated into the model. The Bloomberg prepayment model is suggested because the well-organized sub models are established and the data is completed to capture the prepayment behaviours. Also due to MBS is now the most common investment vehicle in the US fixed income market, trading MBS in the real world is also an important part to dig in. The Option adjusted spread method for trading MBS is selected in this study for studying the trading strategy of MBS to better understanding this blockbuster fixed income investment tool.

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1 Introduction

An important capital market innovation gaining popular acceptance in the 1980s has been the mortgage-backed security (MBS) and its derivatives. These securities have been the target of considerable analysis by both investment bankers and academics; however their valuation remains an unresolved issue. MBS are created through a process of securitization in which mortgage originators sell mortgages to private firms or government agencies such as Government National Mortgage Association (GNMA) or government-sponsored enterprise (GSE) such as Fannie Mae or Freddie Mac. These mortgages are packaged into relatively homogeneous pools and placed in the custody of a trustee. The pools are used as collateral for the insurance of mortgage-backed securities. As a result of increasing investor interest in these investments, the mortgage securities market is one of the largest financial markets in the world. Total volume of outstanding mortgage securities exceeded $8.7 trillion so far as the end of May 2006. New issuance of agency pass-throughs for 2005 was $987 billion, while there is $1010 billion in 2004 and $ 387 billion so far 2006.(See the table 2 in the appendix)

To be announced (TBA) market is the unique trading mechanism in the pass through securities including MBS issued by Fannie Mae, Ginnie Mae and Freddic Mae and CMO. Through this mechanism the pass through securities could be traded before the settlement day for one to three months. For example a Fannie Mae 30 years tenure with 5.5% coupon rate settlement day at September 2006 could be traded in through TBA market on June 2006 (See appendix table 5 to 7). To be announced (TBA) means the underlying pool of the mortgage won't be announced until the settlement day. Through TBA market issuers such as Fannie Mae Ginne Mae and Freddic Mae have more time to arrange the pool with similar cash flow. For investors such as insurance company can still have good liquidity when they buy MBS in the TBA market (See appendix table 8). Even the security has not been settled yet. Whenever there is a mortgage pass through securities comes to TBA market, the coupon and the tenure and the issuer are confirmed. So even though the security bought from TBA market has not really been settled yet. Investors have no extra risks such as credit concerns. we can say that the TBA market (shown in

the appendix) in the states contributes the development for the whole pass through securities.

There are many derivative products of MBS, each fulfilling a different investor need. These products including collateralized mortgage obligations (CMO) which merged since 1980 to give the market another taste for those investors who don't like to face the disadvantage of MBS: prepayment risk; and strips mortgage backed securities including interest only (IO) and principal only (PO) portions of the security are sold separately.

The valuation of MBS and their derivatives is very sensitive to the prepayment behaviour of mortgages. Basically comparing to equity valuation, fixed income is easier for valuation due to more stable cash flow estimation. But in pricing MBS the cash flow is quite unstable comparing to original bonds because of the mortgage borrower's prepayment behaviour. This features name the major difficulty of pricing MBS and other fixed income product with certain cash flow. The major focus of this paper would like to focus on describing the unique characteristics of MBS and show how the valuation of MBS is decided through systematic analysis.

The dominant consideration in the valuation of mortgage-backed securities (MBS) is modelling the prepayments of the pool of underlying mortgages. And generally the major factor that influences prepayments is interest rate. No mater in 1 factor 2 factors model or 3-factor model, interest rate play a very important role in reflecting people's behaviour of prepayment. Current industry practice is to use historical data to model the interest rate process and prepayment behaviours. In this study we will use the model developed by Bloomberg to study the trading strategy for MBS. The model combine the process starting from interest rate simulation and then estimate the repayment behaviour to get each cash flow for the remaining life of the security then using the Option Adjusted Spread technique to interpret the price of the securities then to figure out the practical trading strategy.

Since Mortgage backed securities present the second trading volume and outstanding volume in the US fixed income market, lots of studies have been made to

cover the basic but the most important parameter, interest rate process. The contemporary literatures regarding the interest rate process can be divided into two categories equilibrium interest rate model and no-arbitrage interest rate model. Both of these two categories have their characteristics and can be used to different cases. The major difference would be the equilibrium interest rate model tend to make assumption to the economic environment and then derive the process from the short-term risk-free rate then together with other assumption regarding the long-term interest rate and to get the term-structure. Since Vasicek (1977,1982) a lots of literatures published to give us useful models such as CIR model (1985) and Brennan & Schwartz (1979,1982) providing either one factor model or two-factor model to capture the interest rate.

The no-arbitrage interest rate model uses current market price as the given constraints and then derives the implicit instantaneous short rate and uses this rate to give pricing to all interest rate derivatives. In this scenario there is no arbitrage opportunity. Since Ho& Lee (1986) publish their first model, there are lots of literatures measuring the interest rate in the same way such as Hull& White (1990), Black, Derman, and Toy(1990). The major argument of no-arbitrage interest rate model is that the model using the market price to get the parameters of the model, and then using the model to forecast the future short interest rate. But if we see this model in different time frame we will find that there are different parameters of the model in different time so comparing to the equilibrium model it lack of the consistency over time. In the following of this paper Bloomberg LNMR model is chosen to generate the interest rate process and work with the prepayment model simultaneously to predict the cash flow. After all the tasks have been done then we can work out for getting the OAS. OAS then will be applied as the criteria to decide if this pass through security is relatively expensive or cheaper for sell out the position or accumulation position.

Prepayment behaviour by definition is that the payment of all of or part of a debt prior to its due date. And for mortgages it's quite straightforward that homeowners with fixed-rate mortgages tend to refinance their mortgages when interest rates drop, there is a pronounced negative correlation between the level of interest rates and prepayment rates on fixed-rate mortgages. Because of the significance of prepayment for mortgage-backed

securities, the industry has developed metrics for prepayment. These apply to a pool of fixed-rate mortgages collateralizing a mortgage-backed security.

Mortgage prepayments are triggered when a mortgage is paid ahead of its loan schedule. There are different literatures trying to precisely capture the prepayment behaviour through setting up different models. Tuckman (1995) summarizes that mortgage prepayment models can be categorized into three approaches. They are static cash flow model, implied model and prepayment function model. These models include those by Asay, Guillaume, and Mattu (1987); Brazil (1988); Carron and Hogan (1988); Chinloy (1989, 1991); Davidson, Herskovitz, and Van Drunen (1988); Giliberto and Thibideau (1989); Lacey and Milonas (1989); Richard and Roll (1989); and Schwartz and Torous (1989). Among them, a popular one developed and applied to forecast the prepayment behavior, including 12-year average maturity, a multiple of FHA experience, PSA model, SMM model, and such conditional prepayment rate (CPR) methods as simple regression model, logistic model (Navratil, 1985), and proportional hazards model (Green and Shoven, 1986).

Generally speaking, there are four major events to cause a mortgage to prepay. They are home sales, refinance, default and curtailment. There are other events that may trigger the prepayments such as fire and earthquakes. However, the later two are non-financial and impossible to model by econometric models. Becketti (1989) finds that refinancing, relocation, and default are direct causes of MBS prepayments, and the relative coupon is the most important factor in the decision to refinance. According to Spahr and Sunderman (1992), there are four common used prepayment models. The first model formulated by Asay, Guillaume, and Mattu(1987) incorporates only the spread between the prevailing market rate and the loan coupon rate. Chinloy (1991) found three factors that were significant in explaining the monthly prepayment rate of GNMA mortgage-backed securities from January 1986 through May 1989. These factors are the average market rate on newly originated, fixed rate mortgages, the contract rate, and the seasoning or age of the loan. Based on a Tobit specification, Chinloy observed that age and seasoning do not affect the probability of prepayment.

Like Green and Shoven (1986), Schwartz and Torous (1989) use a propotional-harzard model to estimate the influence of various explanatory variables on Ginnie Mae 30 year, single-family pool prepayment rates during the period of January 1978 to November 1987. Unlike Green and Shoven, Schwartz and Torous show the effects of seasoning and investigate the lagged refinancing rates, heterogeneity in mortgages, and seasonality. They use maximum-likelihood estimates and introduce the effect of refinancing costs on the mortgagors' prepayment decision.

The Goldman Sachs model developed by Richard and Roll (1989) and modified by the OTS, captures four important economic effects. These effects are (1) the refinancing incentive; (2) seasoning or age of mortgage; (3) the month of the year (seasonality); and perhaps the least understood, (4) the pool burnout effect. This model measures the refinancing incentive as the weighted average of the mortgage coupon rate divided by the mortgage-refinancing rate.

The modified Goldman Sachs and the Schwartz and Torous models could be compared by the technique and sensitivity with each of the four factors (refinancing incentives, seasoning, seasonality and burnout) is incorporated. According the study made by Spahr and Sunderman (1992) Goldman Sachs model is intuitively preferred to Schwartz and Tourous model in the parameters of refinancing incentive and seasonality, while the pool burnout effect could be better captured by the Schwartz and Tourous than the modified Goldman Sachs model.

Besides the four models mentioned summarized Spahr and Sunderman (1992), In the paper, we will use the Bloomberg prepayment model. Bloomberg prepayment model is another widely used model in the world. As one of the leading global providers of data, news and analytics Bloomberg offer real-time and archived financial market data base, and pricing systems for the investor worldwide. Its prepayment model also plays an important role in the market for providing traders a quick estimation for pricing Mortgage Backed Securities.

After the introduction, the rest of the paper is organized as follows: Section 2 introduces the model to price mortgage backed securities. Section 3 presents the results of the application of the model and implication of trading strategy. Section 4 offers concluding remarks.

2. Pricing the Mortgage Backed Securities

In this session, we introduce the model pricing the mortgage Backed Securities. We will start from the interest rate process model and then introduce the prepayment model. After that we formulate the idea of option-adjusted spread (OAS) and the procedure to calculate its value. We will also introduce the prepayment model developed by Bloomberg which is commonly adopted by the industry for estimate the prepayment behaviours.

2.1 Model Interest Rate Process

The CIR model plays an important role in the systematic analysis of interest rate process. It is widely used than Vasicek's model because the shortage of Vasicek is that it will generate negative interest rate, which can't happen in the real world. After CIR model we will introduce Ho-Lee model and Hull white model, which are the most representative model of the arbitrage free models. We can say that Hull and White models covers all the important features of CIR and Ho-Lee models. Later this chapter we will introduce the Bloomberg Log Normal Mean Reverting Model (LNMR), which methodology is similar to Hull and White model, as the simulation tool of this whole study. we can say that interest rate process plays a very important role for pricing MBS.

Bloomberg offer several analysis tools for making interest rate simulation for pricing the mortgage-backed securities. The one we choose is named Log Normal Mean Reverting Model (LNMR). The Bloomberg LNMR captures the short rate r_t where：

$$r_t = e^{R_t + \theta_t} \tag{1}$$

$$dR_t = -aR_t d_t + \sigma dW_t \tag{2}$$

with a and σ constants, θ_t is a function of time and chosen to calibrate the model to the discount curve. Under this model R_t is a Gaussian process mean reverting to zero and r_t is log normal and mean reverting as we ll. Bloomberg LNMR model offers the interest rate simulation tool with the numerical method Monte Carlo for generating the future interest rate paths. In this study we use the Bloomberg system to run the 32 paths interest rate simulation for a Fannie Mae 30 years security which coupon rate is 5.5%. The results are shown in appendix chart2. The important characteristic of pricing mortgage-backed securities is that we should not only make interest rate simulation but also apply the prepayment modelling together with the interest rate process for capture the cash flow of the securities.

2.2 Model Prepayment

In the financial industry people often use the prepayment model provided by Bloomberg named Bloomberg Prepayment model (BPM). The framework of Bloomberg prepayment model includes four independent components. These four components can be described separately as follows:

Housing Turnover Component -- This component captures prepayments caused by home sales. Home sales, of course, are influenced by a plethora of factors including the number of years since the purchase, the time of year as we ll as current mortgage rates.

Refinancing Component -- A refinancing occurs when the borrower elects to refinance his or her existing loan with one that will carry a lower interest rate. Refinancing depends on current and past interest rates, the loan's age, and the loan type to name a few.

Default Component -- A mortgage default triggers a prepayment through the foreclosure and eventual sale of the home.

Curtailment Component -- Curtailments occur when the mortgagor elects to pay more than the required monthly mortgage payment and reduce the loan's final maturity as we ll as the mortgage pool's weighted average life.

These components are modelled as independent, dynamic sub-models in the BPM. Each sub-model, in turn, is driven by its own relevant variables. For example, the refinancing component is modelled with its own parameters to capture such prepayment phenomenon as seasoning, burnout, the media-effect and pipeline effect.

We have found that modelling each component independently, with a sub-model, increases the model's flexibility and accuracy. As the data providers with abundant data set Bloomberg can adjust the model's parameter to increase its prediction ability. Which means Bloomberg can model prepayment as we ll as quickly adjust the model to constant changes related to mortgage industry innovations as well as borrower behaviour. This characteristic distinguish Bloomberg prepayment model to others.

Mathematically, the output of the Bloomberg Prepayment Model can be expressed as:

$$SMMt = HousingTurnover\_SMMt + Refinancing\_SMMt + Curtailment\_SMMt + Default\_SMMt, \quad (3)$$

where SMMt is the sum of four SMMs (single monthly mortality rates) from housing turnover, refinancing, curtailments and defaults; t is used to denote periodicity in months.

2.3 Option-Adjusted Spread

The most widely used spread is the option-adjusted spread (OAS), which reflects the value of mortgagors' option of refinancing at lower mortgage rates. In using OAS, a few hundred paths of the term structure of interest rates and the spot rates (the theoretical yields on a zero-coupon Treasury) are created via numerical simulations. Each path will generate specific cash flows over time for the MBS, based on proprietary prepayment models, allowing prepayment speed to change as a function of the spot rates. Then, after adding a spread, the OAS, to the spot rate at each point in time, the cash flows of the MBS are discounted to the present at a rate equal to the spot rate plus the OAS. Using the same spread, the present value is computed for all simulated paths of spot rates. The average of all present values is computed and compared to the actual price of the MBS. If the average present value of all paths is equal to the price, the OAS is correct; otherwise a different spread is used until the average present value of the discounted cash flows for each simulated term structure of interest rates is equal to the current price of the MBS.

In equation (4) g is the number of simulated paths of term structure of interest rates; h is path h; and PVh is the present value of the cash flows for path h.

$$\text{AvgPV(MBS)} = \Sigma g \ \text{PVh}/g \qquad (4)$$

where PVh is defined in equation (5) below and corresponds to the present value of the cash flows of the MBS based on path h with its corresponding prepayment speeds. CFht is the cash flow of path h at time t, and RhTSt is the Treasury spot rate at time t for path h.

$$\text{PVh} = \Sigma n \ \text{CFht} / (1 + \text{RhTSt} + \text{OAS})t \qquad (5)$$

Clearly, the OAS of an MBS will differ among the different institutions supplying the calculation. There are two main reasons for the divergence. The first is that simulations of future interest rate paths are random and cannot coincide from one institution to another. Second, the prepayment models used to estimate future cash flows linked to the Treasury spot rates vary among institutions. we could interpret the OAS as the spread above Treasury after stripping away the cost of the prepayment option from the static spread. Once that prepayment-option cost is removed, the OAS represents the true spread left above Treasury.

2.4 Procedure for Calculating OAS

To further understanding the calculation process of getting OAS from Pass through securities, the process could be divided in to the steps as bellow:

1. Interest rate scenarios are generated stochastically, using a model consistent with the current term structure and assumed level of volatility.

2. Free cash flows, reflecting interest-sensitive contractual features, are calculated at each time step along each interest rate path.

3. The free cash flows are discounted at the risk-free interest rate plus a spread (the OAS) to determine a value at time zero for each path.

4. An average of the path wise values is calculated.

5. Steps 3 and 4 are repeated, and the OAS is solved for which equates the average of the path wise values to the current market price.

Option-adjusted spread (OAS) is the spread relative to a risk-free interest rate, usually measured in basis points (bp.), that equates the theoretical present value of a series of uncertain cash flows of an instrument to its current market price. OAS can be viewed as the compensation of an investor receives for assuming a variety of risks (e.g. liquidity premium, default risk, model risk), net of the cost of any embedded options. In

this study We use the tool provided by Bloomberg for calculating OAS. The appendix in this study shows the OAS calculating process by using Bloomberg MBS tool, the common used software in the industry to price the 30 years coupon 5.5 % Fannie Mae. By means of observing the OAS of some common mortgage backed securities, some interpretation could be discussed later in the next section.

3. OAS General Applications and Trading Implications

3. 1 OAS General Applications

OAS is a widely used tool in the industry, the reasons why it's so popular is that it could help investors to set up a benchmark for decision making whenever there are several choices to face. And we can summarize some general applications in the bellow:

1. Evaluation of an interest-sensitive fixed-income security (in other words, a security whose future redemption date and payment stream are influenced by interest rates through the presence of an implicit embedded option). For example, is a 50 bp OAS appropriate for an A-rated asset?

2. Facilitates comparison of assets. For example, is an AAA-rated asset at 90 bp over the Treasury curve a better value than a B-rated asset with a 600 bp spread?

3. Profitability analysis. For example, keep OAS constant and see how price varies as various factors are changed. Or, keep price constant and see how a change in various factors impacts the OAS.

4. Product pricing. For example, when discounting interest-sensitive cash flows, We will ask what the appropriate spread is over the risk-free interest rate that compensates the company for the risks of the product.

5. Firm valuation or valuation of a book of business. For example, when discounting interest-sensitive cash flows, We will ask what spread should be added to the risk-free interest rate in order to compensate the buyer for the risks inherent in the firm or book?

In the following We will use the public traded MBS to estimate the OAS and then comparing to the OAS estimation from the other famous industrial players. Then We try to build up a trading strategy.

The security chosen for study are 30 years Fannie Mae, Ginnie Mae and Freddie Mae coupon rate 5.5%, which tickers in Bloomberg is FNCL, G2SF, FGLMC, respectively, GSSF, another Ginnie Mae frequently traded security is also selected for better demonstration how different between different agency issuers.

As We can find the result in table 1, that MBS issued by Ginnie Mae always trade in the lower OAS while Freddie Mae are usually trade in the highest OAS relatively. Even the assumptions of volatility and PSA are the same in calculating OAS between different issuers. The interpretation We can make is that only Ginnie Mae is fully guarantee its cash flow by US treasury for its interests and principal. So We can say that even all these three agencies have the same credit as US government bond, which is AAA. But investors tend to trade Ginnie Mae in the higher price, which means lower OAS level for compensating the potential default risks between the 3 agencies. In the real world we observe that the same behaviour done by major central banks besides US, they prefer to buy Ginnie Mae as their foreign reserve position than Fannie Mae and Freddic Mae.

Table 1. OAS comparisons between different issuers with the same coupon, tenor, volatility, and PSA

Security	Coupon	Price	OAS	Volatility	PSA
G2SF	5.5	97-7	61.4	15.2	166
FNCL	5.5	96-21	72	15.2	166

FGLMC	5.5 96-23	73	15.2	166
GNSF	5.5 97-20	54.4	15.2	166

In Table 2 we can observe that the OAS estimation comparison between 30 years Fannie Mae and Ginnie Mae using the underlying in the TBA market in July 2006. WAL means weight average life describing the cash flow weight by the time frame. Underlying with higher coupon tend to have shorter WAL due to the significant refinancing incentive drive the prepayment behaviour. Also using the same simulation parameters, the OAS tend to increase as the coupon of the MBS increase

Table 2. OAS comparisons between different issuers with the same tenor, volatility, and PSA but different coupon

TBA for Month July					
GNSF 30			**FNCL 30**		
Coupon	**OAS**	**WAL**	**Coupon**	**OAS**	**WAL**
4.5	**55**	**8.7**	**4.5**	**74**	**9.2**
5	**52**	**8.8**	**5**	**73**	**8.9**
5.5	**59**	**8.36**	**5.5**	**75**	**8.4**
6	**57**	**6.9**	**6**	**74**	**7.2**
6.5	**74**	**4.6**	**6.5**	**69**	**4.9**
7	**87**	**4.7**	**7**	**96**	**3.6**
7.5	**102**	**3.9**	**7.5**	**113**	**4.1**
8	**95**	**3.3**	**8**	**90**	**3.3**

In the table 3 we can observe the OAS might change whenever the volatility of the interest rate increase. Such simulation could give us the idea about the OAS estimation

tends to decrease whenever the volatility increases. This result is quite intuitive because the value of the prepayment option tends to enlarge as the volatility increase. As the OAS is defined as the difference between static spread and the option cost, the results of the simulation would be straightforward. This idea could help us make decision when We are in the economic environment such as the June of 2003.

Table 3. OAS comparisons between different issuers with the same tenor, volatility, and PSA but different coupon

	FNCL 30		GNSF 30	
Volatility	**OAS**	**Option Cost**	**OAS**	**Option Cost**
14.4	73.6	29	57.2	33
15	71.7	31	55.2	35
16	67	35	50.6	40
17	63.3	39	46	45
18	58.8	44	41.2	49
19	54	48	36.3	54
20	49.6	53	31.3	59

In Table 2,.3, we can know the relationship between OAS and the imbedded coupon rate and how the OAS changes whenever the volatility level and the PSA moved as the market condition changed. But we should also be reminded that some basic relationship between the OAS and other parameter might change if the underlying is in special condition. Shown in Table 4, we can see that the comparisons between the OAS and the coupon rate, we can see the basic relationship might change whenever the coupon rates are above 6.5%. The reason for this distortion would be that in the real life the supply of the MBS with coupon higher than 6.5 % are limited in the current economic environment

these days since 2001. (We can see the table in appendix shows the issuance volume with different coupons by agencies)

Table 4. OAS comparisons between different issuers with the same different coupon

	30 YR GNSF	30 YR FNCL	30 YR FGLMC	30 YR G2SF
Coupon	OAS	OAS	OAS	OAS
5.00	50.8	79	83.5	62.9
5.50	55.2	77.8	80.5	63.8
6.00	56.8	73.5	75.3	64.6
6.50	65.2	70.5	72.1	64
7.00	77.4	86.6	94.1	94.1
7.50	93.9	93.8	94	110.8
8.00	95.4	75.9	88.3	102.9

Intuitively, when we trade MBS We should find the security with relatively higher OAS because higher OAS means relatively cheaper. But we should keep in mind that when We try to compare different securities especially from different issuers, We should notice the absolute value should be adjusted by the agency's historical OAS level. Through continuously observing the historical OAS we can develop the intuition to make judgement for the market condition and the nature behind the market such as the example of Ginnie Mae just mentioned.

3.2 Trading strategy

Besides the general application mentioned in last paragraph, OAS also could give us some ideas for trading MBS together with all the other fixed income securities. Ever since Harry Markowitz proposed his famous theory, Modern portfolio theory (MPT), which introduce the concept of diversification, sophisticated investors tend to add increase the efficient frontier through add more assets which have different correlation or risk and return characteristic features to the existing portfolio. MBS as its embedded option features can also play an important role when people build up a fixed income portfolio. Later this chapter we will try to cover some trading strategy that can be implemented using the OAS concept within different the market conditions.

3.2.1 Trading idea when the market volatility goes up

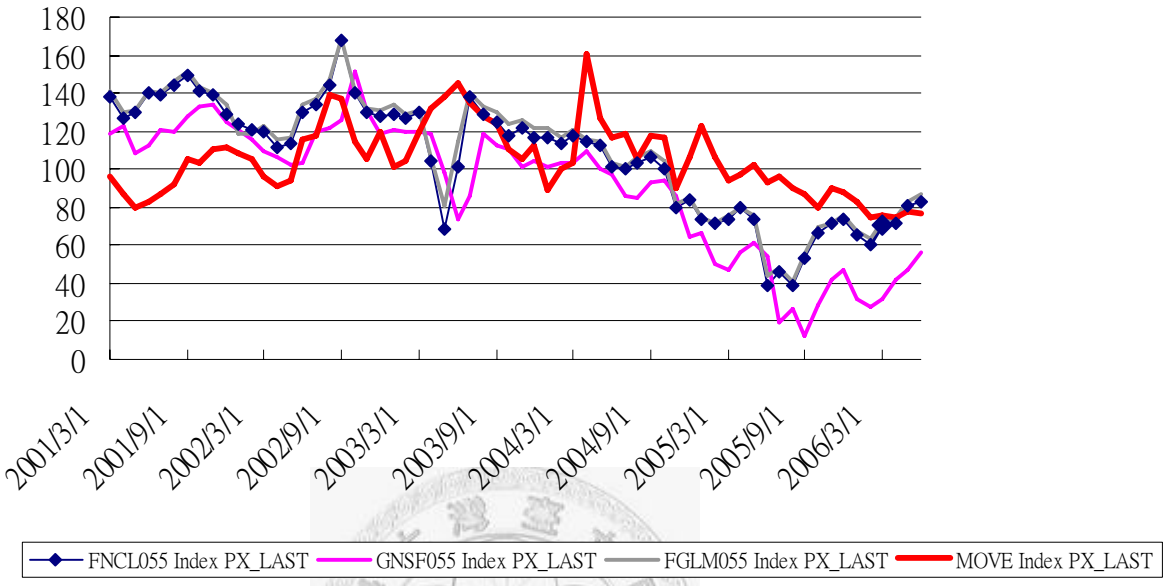
Since the major difference between the conventional bond and MBS would be the embedded call option. One simple idea could be highlighted for further tracking by observing the relationship between MBS price and the volatility. If We can make dynamic position shift between the conventional bonds and the MBS whenever the option value varies due to the market condition changes. Then we can make yield enhancement to the portfolio. We can see Table 5 as an example for explaining the relationship between volatility and the MBS price. If we hold the OAS to be constant and other parameters and assumptions being equal we can observe the inverse relationship between the volatility and the Price. This relationship is also intuitive. Since the value of the option increase when the volatility goes up. Homeowners tend to exercise the prepayment options when they are in the rising volatility environment. But for the investors who own the MBS position, it's like that they sell a call option in the market. So if the value of call option we nt up because of the volatility increased. Investors will suffer for the drop of the market price in the investment periods.

Table 5. Volatility, Option costs and Price movement

Fannie Mae 30 year Coupon 5.5%		
Volatility	Option Cost	Price
13.9	23	95.5
15	27	95.34
20	48	94.43
25	70	93.6
30	93	92.86
35	116	92.18

A strategy could be implemented in order to enhance the yield of the fixed income portfolio by shifting the MBS position to the other fixed income vehicles without embedded options. Using 30 years agency MBS coupon rate 5.5% including Fannie Mae, Ginnie Mae and Freddic Mae for empirical studying, We can see the results shown in the Figure 1. How can we interpret the result? And what can we do through applying the implication of the phenomenon we observe in the market. Let's come back to the basic concept of MBS. Basically investors who bought a MBS can be viewed as they sell a call option to the mortgage owners so they can exercise this prepayment option when the market conditions are favour them to do so. Whenever the market volatilities go up then the value of the call option rises as well. And the higher value of call option gives the homeowner an incentive to exercise this call because the option should be in the money. But for the MBS investors who buy MBS via TBA market, such conditions bring the market price dropping. Since the pay-off between buying a call and selling a call should be complementary. The market price tend to drop when the volatility increase.

Figure 1. OAS movement V.S market volatility



3.2.2 Trading idea when the interest rate goes up

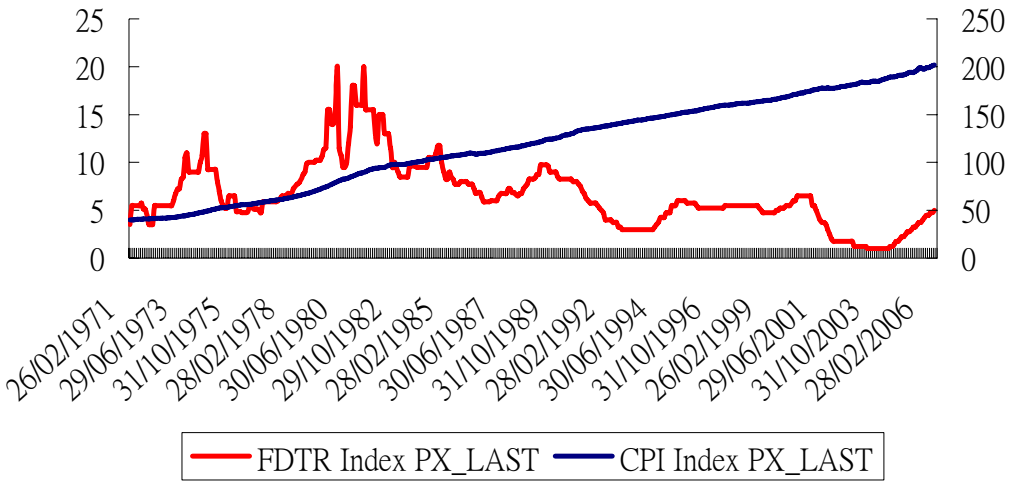
When it comes to fixed income investment we should always be aware of the risk of interest rate hike. The other strategy we could implement in the market is that trying to move the position between different fixed income assets. For MBS investment we can use the characteristics shown in Table 6. As the results in Table 6, MBS with higher coupon tends to have lower effective duration. The intuition would be that MBS with higher coupon tend to have fewer prices sensitive via interest rate hike.

Table 6. Effective Duration comparisons with different coupon and different issuers

	FNCL 30 Year	G2FB 30 Year	FGLMC 30 Year
	Effect Duration	Effect Duration	Effect Duration
Coupon 4.5	6.4	6.7	6.5
Coupon 5.0	6.1	6.2	6.1
Coupon 5.5	5.5	5.6	5.5
Coupon 6.0	4.5	4.6	4.6
Coupon 6.5	3.4	3.7	3.5

This strategy could help minimize the fluctuation of the MBS portfolio. If We do want to make more yield enhancement by actively using the idea stated above. Then We can put more efforts for the forecasting of the interest rate direction and then We can move the MBS position to those with higher coupon rate or via versa. Figure 2 shows the historical data regarding the US Fed fund rate movement and usually we will regard CPI to be an indicator for casting. More econometric tools could be applied for predicting the future movement of the interest rate and help to formalize the strategy and make improvement time to time.

Figure 2, US Fed fund Rate and Consumer price Index



To sum up in this session, We would like to say that MBS as one of the investment vehicle plays an important role in the fixed income investment. Through better understanding of the characteristics of MBS, some strategy could be implemented for either making yield enhancement or risk control. And the whole investment could be benefited through adding MBS into the whole portfolio. From section 3.1 to 3.3, We introduce the Option Adjust Spread (OAS) and in section 3.4 to 3.5 We mention some general application and trading strategy based on the use of OAS. But seems every instrument might have its limits for application. In 3.6 We will cover the strengths and weakness of OAS for a reminder when we use OAS.

3.3 The Strengths and weakness of OAS

Every tool has its advantage and disadvantage. When we use OAS we also need to pay attention to know the limits of it. In the paragraph bellow, strengths and weakness of OAS had been summarized to provide the clear ideas to know the limits for using OAS.

Table 7. Strengths and weakness of OAS

Strengths
1. Allows explicit measurement and representation of risks when pricing products.
2. Stochastic valuation provides a better representation and range of the modelled risk.
3. Stochastic analysis captures the effect of yield curve shape on interest-sensitive variables and reflects the possibility interest rates will vary in the future.
we aknesses
1. Measure is contingent on quality of model and assumptions.
2. Market price may not be available.
3. Only OAS's of securities with similar "embedded options" can be compared.
4. Need for many scenarios may be time-consuming.

Whenever a market price is not readily available due to an illiquid market several methods could be adopted which are described as bellow:

1. Find the price for traded assets that have similar risk,

2. Compare to prices offered by other companies on similar products,

3. For blocks of business, determine the price of product portfolios that are selling in the reinsurance market.

As we mentioned in the first of this chapter every tool or mechanism has its advantage or disadvantages, but We can still say that OAS do provide as a important benchmark when We come to invest pass through securities. We can say that OAS is one

of the most sophisticated methods on the cutting edge of valuing pass through securities. But everyone should still be cautious when using OAS as the criteria to making investment decisions.

4 Conclusions

OAS is the common used method to apply for the decision making of trading Mortgage Backed Securities. For valuing the Mortgage Backed Securities, several procedures should be completed. First the interest rate process should be decided to generate the interest rate process and then the prepayment model should also be set to estimate the cash flow. After the cash flow of the specific MBS had been decided, OAS could be estimated according to the observed price. we can say that according to the OAS We got from the model, trading strategy could be made. The higher the OAS we got from the model, the cheaper the underlying MBS would be. Option Adjusted Spread could also reveal the credit risk implied by the underlying, for example Fannie Mae, Ginnie Mae, Freddic Mae with the same maturity and coupon, Ginnie Mae shows the lowest OAS which means the credit risk is the lowest due to only Ginnie Mae is fully guaranteed by the US government for its interest and principal. In the daily trading, investors can also set its own trading strategy according to his or her experience of using OAS. Let's say different traders might have different interpretation when he observes the movement of the price of pass through securities. And strategy might be adjusted time to time for the accumulation of experience. For example not only the interest rate process and the prepayment model can affect the price of the MBS or said OAS. Dedicated trading inflows also affect the price of MBS quite a lot. For instance, most of the central banks worldwide tend to prefer trading Ginnie Mae than Fannie Mae and Freddic Mae. Investors from Japan usually prefer the underlying issued by Fannie Mae than the other two agencies. This kind of behaviour could not just be interpreted by statistics. It takes time and experience to interpret well the OAS we got from any kind of model. And this part might be the most interesting part for further study, it's because We can try to not only estimate the price of the underlying mortgage pass through securities at the time one

We invest, but We can also build a strategy for trading in order to get the capital gain together with the accrued interests.

This study covers the common used method of interest rate process and prepayment model. OAS is used in this paper as the tool for investment target screening and trading strategy making. When we choose this topic as my thesis focus, at the very beginning my idea is trying to build my own model including the both parts of interest rate process and the prepayment model. But finally we use the model built by Bloomberg in this study as the calculation tool for OAS estimation. The major reason for me to give up building my own models is that due to practically it is hard to get the prepayment behavior data. The database could hardly be accessed. Parameters mentioned above like housing turnover, seasoning, burn out effects could not be accessed due to they are not published data. And most of the investment banks that provide models for users to estimate the valuation of the pass through securities treat their data and models together as the proprietary systems. The advantage of the Bloomberg model is that it offers a clear framework of its model and its proprietary prepayment model can be easily operated. Come back to my initial purpose of better understanding of pass through securities and the trading strategies these securities. What We need to know is just a working model, which We can access easily and provide clear theoretical structure of its model building. The Bloomberg functions are enough for me for playing a role of working models. Maybe We can say that for a security like MBS, probably there is no true model in the world. But as playing a role as working model, probably the one offered by Bloomberg is enough.

Another side feeling we have after completing this study is that Taiwan really needs to make more efforts in the financial innovation area such as MBS. Especially when we compare the fixed income market between Taiwan and US, the gap might be far more than we expected. Today we can't even build a representative yield cures, the 10 years Taiwan government bond's yield is far bellow the one of US. The fixed income capital market of Taiwan still has a long way to go. And this can also be described why the people tend to invest their asset in equity market and every time when the equity market pullback a lot, people tend to suffer a lot. Let's say if we want to have a nice car like

Porsche then what we need to also have is the highway. If Taiwan would like to play a key role in the Asia pacific, fixed income products might be a good angle to start with.

In the last of this study, we would like to say further studies for this topics could be made in the future by others who also have interests in related areas, for example like building up a database to capture people's prepayment behaviour which is also meaningful for the government related department to have more understanding about people's reaction to refinance regarding the interest rate policy. And it might be a big plus for leading the Taiwan fixed income market to a reach the commending height of emerging Asia.

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