

## **MORTGAGE-BACKED SECURITIES (MBSs): EVOLUTIONARY RESPONSE OF THE MBS MARKET TO RISKS ASSOCIATED WITH THESE SECURITIES**

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### **Abstract**

*During the 1970s, investment banks began to securitize mortgages, particularly home mortgages. Individual mortgage loans were pooled together and then sold off, in pieces, to investors. The primary objective of the development of a secondary mortgage market was the improvement of lender liquidity. A mortgage-backed security is either an ownership claim in a pool of mortgages or an obligation that is secured by such a pool. These claims represent securitization of mortgage loans.*

*Mortgage-backed securities are attractive investments for investors for such reasons as high return and no default risk, diversification, and promotion of desirable social goals. In spite of these advantages, increased investment in mortgage-backed securities may be inhibited by such considerations as unattractive risk-adjusted returns and complexities of mortgage-backed securities. The risks associated with mortgage-backed securities include the prepayment risk, contraction risk, and extension risk.*

*Mortgage-backed securities usually yields more than Treasury securities. The spread between 10-year mortgage-backed securities and Treasury securities is about 100 and 125 basis points. Over the business cycle, they outperform Treasuries, but during heightened volatility, they perform much worse.*

*Mortgage-backed securities could be used in emerging markets as alternative investment instruments as long as some issues are considered: A well functioning system, state of housing market, stability in interest rates, and costs.*

### **Özet**

*1970'lerde yatırım bankaları özellikle ev (mesken) ipoteklerini menkul kıymetleştirmeye başladılar. Ayrı ipotek kredileri bir havuzda toplandıktan sonra parçalar halinde yatırımcılara satılmaya başlandı. İkincil ipotek piyasasını geliştirmedeki temel amaç borç verenin likiditesini geliştirmekti. İpoteğe dayalı menkul kıymet, ya bir ipotek havuzundaki sahiplik hakkı ya da böyle bir havuz tarafından garanti edilmiş (teminat sağlanmış) bir yükümlülüktür.*

*İpoteğe dayalı menkul kıymetler, yatırımcılar için yüksek getiri ve ödenmeme riskinin olmayışı, çeşitlendirme ve sosyal amaçları destekleme gibi nedenlerden dolayı cazip yatırım enstrümanlarıdır. Bu avantajlarına karşılık, bu menkul kıymetlere yapılacak yatırım, cazip olmayan riske göre getiri ve bu enstrümanların karmaşık olmaları gibi nedenlerden dolayı cazibesini yitirebilir. İpoteğe dayalı menkul kıymetler, peşin ödeme riski, daralma riski (faiz oranlarındaki düşmeden kaynaklanan risk) ve genişleme riski (faiz oranlarındaki yükselmeden kaynaklanan risk) olmak üzere üç çeşit risk taşırlar.*

*İpoteğe dayalı menkul kıymetlerin taşıdıkları risklere karşı farklı yatırımcıların farklı beklentilerini karşılamak üzere piyasa, çeşitli dayalı kıymet alternatifini yatırımcılara sunmuştur.*

*İpoteğe dayalı menkul kıymet pazarı 1980'lerin başlarında sermaye piyasalarının en hızlı gelişen sektörü iken, 1980'lerin sonlarında kısa vadeli faiz oranlarındaki yükselmeden olumsuz etkilendi. İpoteğe dayalı menkul kıymetler genellikle hazine kağıtlarından daha fazla getiri sağladılar. Uzun dönemde onlar hazine kağıtlarından daha iyi performans göstermekte beraber, volatilitenin arttığı dönemlerde daha kötü bir performans sergilerler. 10 yıllık ipoteğe dayalı menkul kıymetler ile hazine kıymetleri arasındaki fark (spread) yaklaşık %1 - %1.25 arasındadır.*

*Bu menkul kıymetlerin en yaygın olduğu ülke ABD'dir. Bu ülkede, bu menkul kıymetlerin piyasadaki miktarı neredeyse Hazine kağıtlarına yakındır. Avrupa ülkelerinde de bu menkul kıymetler yavaş gelişmektedir.*

*İpoteğe dayalı menkul kıymetler, Türkiye gibi gelişmekte olan piyasalar için yenidir. Bu menkul kıymetlerin bu piyasalarda çıkarılması için, iyi işleyen sistemin varlığı, gerekli hukuki çerçevenin oluşturulması, konut piyasasının durumu, faiz oranlarının istikrarı ve maliyetler gibi konuların göz önünde bulundurulması gereği vardır.*

## **1. Introduction**

Until the 1970s, almost all home mortgages were written for a long-term (15- to 30-year maturity), with a fixed interest rate over the life of the loan, and with equal fixed monthly payments. Fixed-rate mortgages have posed difficulties to lenders in years of increasing interest rates. During the 1970s, investment banks began to securitize mortgages, particularly home mortgages in order to improve liquidity. Individual mortgage loans were pooled together and then sold off, in pieces, to investors. The growth of this secondary market substantially changed the mortgage business.

In early 1980s, increased demand and sophistication led to the introduction of various mortgage-backed securities, and during the 1980s, this market has substantially grown.

The fact that mortgage-backed securities are interest rate sensitive instruments makes them complex securities. This paper, after explaining basics of mortgage-backed securities, elaborates on risks associated with mortgage-backed securities as a result of interest rate sensitivity and evolution of mortgage-backed securities in response to risks associated with them. Pricing methods for mortgage-backed securities and some implications for emerging markets have also presented in the paper, as well as market performance of mortgage-backed securities.

## **2. Mortgage-Backed Securities**

### **2.1. Definition**

A mortgage-backed security is either an ownership claim in a pool of mortgages or an obligation that is secured by such a pool. These claims represent securitization of mortgage loans. Mortgage lenders originate loans and then sell packages of these loans in the secondary market. Specifically, they sell their claim to the cash inflows from the mortgages as these loans are paid off. The mortgage originator continues to serve the loan, collecting principal and interest payments, and passes these payments along to the purchaser of the mortgage. For this reason, these mortgage-backed securities are called *pass-throughs* (Bodie, Kane, and Marcus, 1993, p.56).

Although pass-through securities often guarantee payment of interest and principal, they do not guarantee the rate of return. Holders of pass-throughs can be severely disappointed in their returns when interest rates drop significantly. This is because homeowners usually have an option to prepay the remaining principal.

### **2.2. How Mortgage-Backed Securities Emerged**

The pooling of residential mortgages for the purpose of issuing mortgage-backed securities has proliferated and undergone numerous innovations over the past 20 years.

Until the 1970s, banks made mortgage loans and held them until maturity, collecting principal and interest payments until the mortgages were paid off. This primary market was the only mortgage market. During the 1970s,

however, investment banks began to securitize mortgages, particularly home mortgages. Individual mortgage loans were pooled together and then sold off, in pieces, to investors. The growth of this secondary market substantially changed the mortgage business (Tuckman, 1995, p. 223).

The primary objective of the development of a secondary mortgage market was the improvement of lender liquidity. Because the typical lender generally has only a limited amount of loans available for mortgage loans, the number of mortgages that the lender can issue is limited. The secondary market helps remedy this situation. It allows the lender to take mortgages held in the portfolio and either sell them individually or pool them with similar mortgages to provide collateral for the issuance of a mortgage-backed security. By selling this commodity, the lender is able to maintain a cash position and originate new mortgages, continuing the mortgage origination process and providing better service to retail customers. In addition, this process allows greater use of the limited amount of the loanable funds while lowering costs for borrower. Lenders can improve their yields and profits by extracting the commitment fee and closing costs from the borrower. In addition to enhancing profitability with the fees received from the origination of new mortgages, the secondary market allows the lender to receive additional fees as the mortgage servicer after the sale or securitization of the mortgages (Duett, 1990, p. xiii-xiv).

Mortgage-backed securities were first introduced by the Government National Mortgage Association (GNMA, or Ginnie Mae) in 1970. GNMA pass-throughs carry a guarantee from the U.S. government that ensures timely payment of principal and interest, even if the borrower defaults on the mortgage. This guarantee increases the marketability of the pass-through.

In the early 1970s, mortgage-backed securities (MBSs) were synonymous with GNMA. In the mid-1970s, the Federal Home Loan Mortgage Corporation (FHLMC, or Freddie Mac) became an active participant in the mortgage-backed securities market. Fully amortizing, single-family residential conventional loans were brought by Freddie Mac and substantially reissued with a government agency backing as FHLMC Participation Certificates (PCS).

The single largest contribution to the maturity and depth of emerging mortgage-backed securities business occurred in 1981, when both Freddie Mac and Fannie Mae began their swap programs. The ability of portfolio lenders to swap seasoned whole-loan mortgage inventory into newly issued FHLMC PCs and FNMA MBSs enabled the swapping institutions to create more standardized-and thus more liquid-collateral (Lederman, 1987, p. 136).

The emphasis on mortgage investment for the rapidly expanding mortgage-backed securities investor base led to the creation of the collateralized mortgage obligations (CMOs) and many other derivatives.

### **2.3. Advantages of Mortgage-Backed Securities**

Mortgage-backed securities are attractive investments for investors, particularly for institutional investors, for the following reasons:

*1. High return and no default risk.* Mortgage-backed securities have a yield spread of more than 125 basis points over Treasuries because of their indeterminable cash flow, which is affected by the rate of prepayment. This makes them rate-sensitive instruments (ABA Banking Journal, Feb, 1987, p. 31).

In addition to having higher yields than comparable securities, government guarantees make mortgage-backed securities essentially free of default risk.

*2. Diversification.* The addition of another class of security to a portfolio increases diversification. Mortgage-backed security returns are less than perfectly correlated with stock and bond returns and thereby reduce portfolio volatility when they are added to portfolio (Elebash, 1987, p. 24).

*3. Promotion of desirable social goals.* Funds for home loans are freed when pension funds and other investors buy mortgage-backed securities. The liquid assets of primary lenders (e.g., savings and loans) are replenished when their mortgages are sold to mortgage pools. Home building is an attractive political objective, and it is not unusual for elected officials and lobbying groups to put pressure on state plan trustees to increase mortgage investments (Elebash, 1987, p. 24).

## 2.4. Disadvantages of Mortgage-Backed Securities

In spite of the advantages mentioned above, increased investments in mortgage-backed securities may be inhibited by several considerations:

*1. Unattractive risk-adjusted returns.* Although the nominal returns on mortgage-backed securities are high and they are free of default risk, the nominal return may not be so appealing when adjusted for other instrument risks and certain complexities. Risks mortgage-backed securities face include prepayment risk, contraction risk, and extension risk. These issues will be addressed later in the paper.

*2. Complexities of mortgage-backed securities.* Such factors as indefinite maturities and lack of call protection discourage investors, particularly pension funds, from investing in mortgage pools. Since homeowners almost always have prepayment option--the privilege of calling in their loans early-- , periods of sharply lower interest rates create significant reinvestment risk for mortgage holders. This is critical for plans that aim to match asset maturities with liability maturities at locked in rates of return.

The trustees and managers are also influenced by political as well as investment objectives. Most institutional investors have investment policies that describe risk and return objectives.

## 3. Risks Associated With Mortgage-Backed Securities

Mortgage-backed securities' lack of predictability is the main reason they yield on average 1% better than Treasuries of comparable duration. Since mortgage-backed securities are interest rate sensitive instruments, the lack of predictability is resulted from fluctuations in interest rates. To assess the value of mortgage-backed securities, it is essential to predict prepayments accurately and to understand how prepayments will fluctuate when interest rates fluctuate. However, since the models developed for valuing mortgage-backed securities are theoretical in nature, practitioners introduced different kinds of mortgage-backed securities with the help of technological sophistication in order to cope with risks associated with mortgage-backed securities. This section analyzes several risk exposures resulted from interest rate fluctuations: prepayment risk, contraction risk, and extension risk.

### 3.1. The prepayment risk

Most residential mortgages allow the borrower to prepay the mortgage; therefore, homeowners have right to prepay mortgages, without penalty, partially or in full before scheduled maturity.

The main reason for prepayment is the opportunity for the homeowners to refinance their mortgages at a lower interest rate.

The prepayment option is most valuable when mortgage rates have fallen. In that case, the value of the mortgage exceeds the principal outstanding. Put another way, the value of the mortgage's future cash flows exceeds the principal outstanding. Therefore, it may be worthwhile for a borrower to pay the bank the principal outstanding and not make those future cash flows (Tuckman, 1995, p. 227).

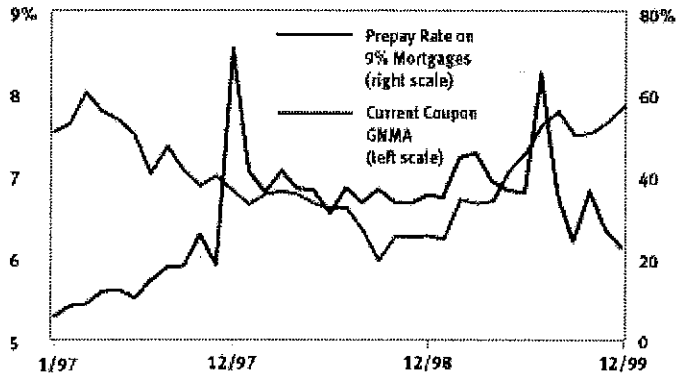
Another reason for prepayment is the sale of a home when the new buyer cannot assume the existing mortgage. Mortgages may be assumable or due-on-sale. If a mortgage is assumable, someone who buys a home may take over the mortgage at the same rate of interest. If mortgage is due-on-sale, the outstanding balance must be paid at the time the home is sold.

There are involuntary reasons for prepayment as well. Examples include natural disasters like fires or hurricanes that destroy the home and can cause the insurer to pay off the mortgage to the lender, and defaults that generate prepayments because mortgages become payable in full when the borrower fails to make a payment.

For investors in mortgage-backed securities, unpredictable prepayments of principal are serious problem. If interest rates fall, lower mortgage rates induce homeowners to pay off their existing mortgages by refinancing. If the mortgages are repaid early, then the bonds will also be prepaid, and investors must then reinvest in lower yielding securities. As interest rates rise, refinancing activity slows. Mortgage investors who anticipated an early return of their principal now see their funds tied up for longer periods as refinancing slows. Because accurate forecasting of interest rates over any lengthy period of time is impossible, this prepayment variability is an on-

going dilemma for mortgage-backed security investors (Guttery and McCarthy, 1995, p. 19).

**Figure 1. Prepayment Effect**  
**GNMA Yields and Prepayment Rate on 9% 30-Year Mortgages**  
**1997-1999**



Source: T. Rowe Price Associates, 2000

As you can see by the graph (Fig. 1), prepayment activity was fairly low for most of 1997 but spiked higher late in the year as interest rates tumbled in response to the Asian crisis. Prepayment activity remained strong throughout 1998 as rates continued to fall. In 1999, rates climbed steadily, and prepayment activity spiked higher again at mid-year when Federal Reserve started raising short-term rates. For the rest of 1999, prepayment activity tapered off (T. Rowe Price Associates, 2000, p. 4).

### 3.2. Contraction risk

Contraction risk is the combination of two effects, namely negative convexity and reinvestment risk. Convexity measures the rate at which duration (that is the weighted-average time to receipt of a bond's cash flows and a measurement of a bond's price sensitivity to changes in interest rates, where greater duration means greater sensitivity and greater risk), changes in response to changes in interest rates. Positive convexity is the case where the security becomes less price sensitive as interest rates rise. As it is obvious, negative convexity is the opposite where the security's duration length-



ens when rates rise and shortens when interest rates fall. Whereas bonds with fixed cash flows have a positive convexity, Mortgage-backed securities, which can be prepaid, often have a negative convexity.

When mortgage market rates fall and homeowners accelerate their financing, contraction risk affects mortgage-backed securities in two ways. First, because of negative convexity, the bond's price will not increase as much as an equivalent non-callable alternative like a Treasury bond. Second, mortgage-backed security holders receive more rapid prepayments of principal, which they must reinvest at the prevailing lower market rates (Guttery and McCarthy, 1995, p. 26).

### 3.3. Extension risk

Extension risk is the opposite of contraction risk; it is the risk mortgage-backed security investors face from rising interest rates. Raising rates affect mortgage-backed securities in two ways. First, the bond's price drops like any other fixed-income security; however, because prepayments slow with raising rates, the cash flow to the investor drops. This causes the mortgage-backed security's price to fall by more than an equivalent non-callable alternative, like a Treasury bond. The second effect of rising rates is also a consequence of slower prepayments. When rates are rising, mortgage-backed security investors prefer faster repayments so that they can reinvest their principal at the higher prevailing rates. But when prepayments slow down, reinvestment at the higher rates is prevented. The combination of these two effects, greater relative price declines and reinvestment risk, is called extension risk (Guttery and McCarthy, 1995, p. 27).

Mortgage-backed securities act essentially like other high quality bonds of similar maturity. They fluctuate in value as interest rates change: falling rates generally result in higher prices, and rising rates generally lead to lower prices. As with all bond investments, there is the potential to lose money when investing in these securities.

Interest rates risk is generally higher with longer-term securities than with shorter-term issues. As the Table 1 shows, the potential change of a bond's value increases with longer maturities, so longer-term bonds are usually more volatile than short-term bonds. The example shows how values of

bonds with various maturities change when interest rates rise or fall by one percentage point. The bonds are assumed to be of equal quality, to have 6% coupons, and to have \$1,000 par values.

**Table 1.** The Impact of interest Rate Risk on Mortgage-Backed Securities

Bond Maturity in Years	Rates fall 1%, and the bond's value rises to:	Rates rise 1%, and the bond's value drops to:
1	\$1,009.63	\$990.50
3	\$1,027.50	\$973.36
5	\$1,043.76	\$958.40
10	\$1,077.90	\$928.90
30	\$1,154.50	\$875.30

Source: T. Rowe Price Associates, 2000.

#### 4. Evolution of Mortgage-Backed Securities

Since mortgage-backed securities are interest rate sensitive instruments, as mentioned earlier, great amount of risk might be associated with mortgage-backed securities. However, in response to these risks, market was fast enough to offer investors attractive alternatives in terms of risk and return through technological sophistication.

The first type of mortgage-backed security, still quite common, is the pass-through.

*A pass-through* mortgage-backed security is a collection of mortgages whose cash flows are passed from homeowners, through the banks and serving agents, to the investors in the security (Tuckman, 1995, p. 240). investors get a pro rata share of payments—some fraction of the monthly mortgage payments includes both principal and interest, investors get a mixture of these elements “pass through” from the homeowners.

These simple forms of mortgage-backed securities have a limited appeal for several reasons. First, it takes years until the last homeowner completely pays off the last mortgage and returns the full value of the principal. Second,

because of prepayment option, pass-throughs also face the risk that payments may arrive on a different schedule than investors initially expected.

In the early 1980s, market participants developed the Collateralized Mortgage Obligations (CMOs) to solve the problems the simple form of mortgage-backed securities, pass-through faces:

*A CMO* is a multi-tranche bond backed by a pool of fixed-rate mortgages, the cash flows from which are channeled into two or more groups of securities with different yields and maturities (The Economist, July 09, 1994, p. 81).

CMOs break the mortgage-backed security into a series of bonds with short, medium, and long maturities. Each tranche gets its share of interest payments, but the principal is repaid sequentially. That is, principal payments go exclusively to the first tranche until it is paid off, then to the second tranche until it is paid off, and so forth.

The idea behind the CMOs is to reallocate the interest and principal cash flows of mortgages in ways that appeal to different investors. For example, investors who want a fast return of capital can buy a five-year issue; those seeking a long-term investment can buy a share in a 20-year pool.

The standard CMO still exhibits two types of risk. Interest-rate risk exists because market rates can change, making the present value of the payment stream worth different amounts. Prepayment risk still exists, and it continues to make the maturity of the bond uncertain. For example, as interest rates fall, more people prepay their mortgages, so each tranche has a shorter maturity. As interest rates rise, fewer people prepay their mortgages, so each tranche has a longer maturity (Haubrich, 1995, p. 2). The standard CMO also carry extension risk. When interest rates rise, the CMO extends at exactly wrong time; that is, when interest rates are high and investors would like to reinvest at the higher rate. When rates fall, the CMO tranche pays off quickly, again at the wrong time. The investor receives more principal today, when interest rates are down, and so must trade the high interest on the original CMO for lower interest on something else. This reinvestment risk offsets, and may dominate, the capital gain or loss stemming from a change in interest rates.

To mitigate these risks, market participants created a new type of tranche--the accrual bond, or Z-bond.

*The Z-bond* acts as a stabilizing influence on the other tranches. This bond gets neither principal nor interest until all previous tranches are paid off. The Z-bond is similar to a zero-coupon bond in that the interest due accrues and it initially makes no interest payment. As prepayment rise, the tranches pay off ahead of schedule and the Z-bond starts making payments earlier than originally anticipated.

Some investors wanted more certainty about their bonds, so the market responded with Planned Amortization Classes (PACs) and Targeted Amortization Classes (TACs) to help isolate the prepayment risk of mortgages.

*PACs* aim to produce mortgage securities that are comparable with conventional bonds, by guessing how many mortgages will prepay. PACs provide principal payments according to a pre-specified schedule.

As long as prepayments stay within a given range compared to a model, such as that developed by the Public Securities Association (PSA), investors in PAC bonds will be repaid according to the original schedule. The PSA model expresses prepayment speed as a percentage of its predicted speed of 100 and investors are guaranteed that if prepayments stay between, say, 75 and 250, they will be paid according to the original schedule (Murray, 1992, p. 53).

PACs are designed by structuring a CMO with two pieces: a companion bond, which absorbs most of the prepayment risk, and the PAC, which is protected by its companion.

It is important to note that although PACs are fairly safe bonds, the process of creating them necessarily shoves more risk into the other tranches. Companion bonds, which receive payments only after the PAC schedule is met, are particularly risky (Haubrich, 1992, p.3).

*TACs* offer a similar sort of protection, but only against prepayments rising. The TAC has priority over other tranches and hence can keep to its

schedule if prepayments increase. If they drop off, however, the TAC has no protection.

When mortgages are pooled, the pool's payments can be split (stripped) into variety of new securities. To enhance investors' ability to buy specific risks, Wall Street went on to separate the interest and principal components into interest only (IO) and principal only (PO) securities.

*A PO Strip* receives just the principal payments. PO strips behave like ultra-volatile zero-coupon bonds. If rates fall, making prepayments more likely, then the amount of time the holder has to wait without receiving a payment falls and so the value rises quickly towards the principal value of the underlying bond. If the rates rise, the price of the PO moves down to a discount representing that current on a zero coupon bond with a maturity of the life expectancy of the mortgage-backed security (Murray, 1992, p. 54).

*An IO Strip* receives only the interest payments on the mortgages. As the underlying bonds start to prepay, the interest receivable drops as the IO holder receives the interest on less principal. If the bonds are prepaid completely, then interest payments stop and the IOs are worth nothing.

Buyers of IOs are betting that prepayments will not occur or will slow down. Buyers of POs are betting that prepayments will speed up (Murray, 1992, p. 54).

Some investors prefer floating-rate securities. Unfortunately, the mortgages underlying CMOs usually have fixed rates. The floater and inverse floater (IF) tranches address this CMO shortcoming.

*The floater tranche's* yield is tied to a short-term rate like the thirty-day Treasury bill or LIBOR. If T-bill rates rise, so does the floater's yield, and if rates fall, the floater's rate drops correspondingly. This variable rate poses a problem for the pool's cash flow, though. Because the underlying mortgages have fixed rates, an increased payment to the floater tranche means less cash is available to the CMO's remaining tranches.

*The Inverse Float(IF) Class* absorbs this shortfall by earning a lower rate when rates increase. Its yield drops as the floater's yield increases and vice versa (Guttery and McCarthy, 1995, p. 24). When interest rates rise, the

price of an inverse floater declines for two reasons. First, it is a mortgage bond which falls in price as rates go up. Second, because it flows inversely with interest rates, its coupon payments go down.

## **5. Pricing Mortgage-Backed Securities**

The cash flows of mortgage-backed securities most closely resemble those of corporate bonds. The match is not perfect, as the prepayment option held by the mortgagor and due-on-sale clause held by the lender introduce additional uncertainty into cash flow projections. The various types of models are used for pricing mortgage-backed securities. These variety of models were divided into four broad categories: 1. Static cash flow models, 2. The implied model, 3. The prepayment model, 4. and Options-based models.

### **5.1. Static Cash Flow Models**

These models assumed that prepayments could be predicted as a function of their age. Typical assumptions are that the prepayment rate increases gradually as mortgages age, then levels off at some constant prepayment rate. Another assumption in the same class is based on data provided by the Federal Housing Authority. This model uses past behavior of prepayments, as a function of age, to predict future prepayments (Tuckman, 1995, p. 234).

Because of its simplicity, this model is widely used in pricing mortgage-backed securities. Despite this advantage, there are some problems with this approach. First, this model does not allow for fluctuations in cash flows as interest rates change. The fact that prepayments will change as interest rates change will affect the pricing of mortgages but is not captured at all in static cash flow models. Second, they provide misleading price-yield and duration-yield curves. The prepayment option substantially alters the qualitative shape of the price-yield and duration curves because mortgage cash flows are not fixed.

### **5.2. The Implied Model**

This model calculates duration for a given security from recent price movements of that security. The use of these recent prices in comparison to

some type of benchmark allows the calculation of an implied duration (Duett, 1990, p. 120). The assumption the implied models make is that the duration of a mortgage changes slowly over time, and based on this assumption, they use recent data on price sensitivity to estimate durations numerically. Another assumption is that market prices are correct indications of value.

The use of market data is viewed as a strength of the model. The second assumption prohibits the incorporation of mispriced securities and does not allow the analyst find mispriced investments.

These models have some drawbacks as well. First, they are not pricing models. Second, parameters calculated from past data do not adjust for structural changes that may occur over the different periods of time.

### **5.3. The Prepayment Function Models**

These models use historical data and any insights the researchers might have to develop predictions about prepayments as a function of several variables that might include the difference between the existing mortgage's rate and currently issued mortgage rates, the age of the mortgage, the steepness of the term structure, the season, and so on (Tuckman, 1995, p. 236). These models improve on the static models, as they recognize the relationship between prepayment rates and interest rates.

These models have a disadvantage, however. They do not allow for theoretical calculations of the prepayment option held by the borrower.

### **5.4. Option-Based Models**

These models allow the inclusion of all three parts of the mortgage contract and include additional variables such as interest rates, a process defining the expected change in interest rates, and a volatility of interest rates. The three parts consists of the fixed stream of cash flows resulting from the contract, the due-on-sale clause, and the prepayment option (Duett, 1990, p. 123). The assumption these models make is that the prepayment feature offers significant value to the mortgagor and can be best valued when considered separate from the mortgage instrument itself.

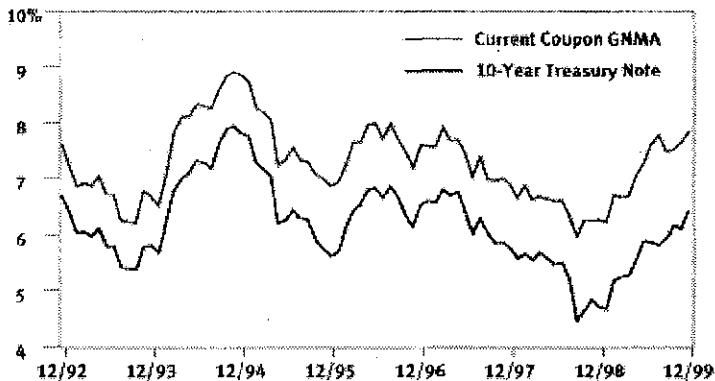
The major advantage of option-based models is their ability to incorporate various interest rate paths. For the practitioner, these interest rate paths should reflect observed interest rate behavior (Duett, 1990, p. 124).

Added complexity and reliability of the variables are the drawbacks of these models. The reliability is a function of past values. The applicability of historical values to the future is dependent on the assumption that no structural shifts will occur.

## 6. Yields on Mortgage-Backed Securities

One of the primary advantages of investing in mortgage-backed securities is that the yield tends to be higher than on U.S. Treasury notes and bonds with comparable maturities, even though there is little or no additional credit risk.

**Figure 2. Yield Comparisons**  
**Yield Comparison: GNMA vs. 10-Year Treasury Note**



Source: T. Rowe Price Associates, 2000.

The graph above shows that the yield of a GNMA certificate, for example, has been at least 125 basis points or one and one-quarter percentage points higher than that of a 10-year Treasury note in recent years. (Mortgage rates are typically set reference to the 10-year Treasury.) On newly issued fixed rate securities, yields will reflect current mortgage rates minus fees



charged for servicing and guarantees, leading to a yield about one-half a percentage point below yields on the pooled mortgages.(T. Rowe Price Associates, 2000, p. 2-3)

### **7. Market Performance of Mortgage-Backed Securities**

Because mortgage instruments are complex and issued in large dominations, the mortgage-backed securities market tends to be dominated by institutional investors. However, individual investors may participate in this market through fixed income mutual funds that invest in mortgage-backed securities.

Mortgage-backed security market was the fastest growing sector of the capital market early in 1980s. This fast growing market was hit hard by the inexorable increase in short-term interest rates from March 1988 to May 1989. The upturn drove away investors, dried volume, and decimated underwriters' profits. Problems were worsened by a weak housing market and too many market participants (Hummer, 1989, p. 60).

Traditionally, the spread between 10-year mortgage-backed securities and Treasury securities has been about 70 to 100 basis points, but during the trouble period, the spread widened to more than 150 basis points.

In the spring of 1987, many investors who had withdrawn money from CDS to buy the funds--not being informed of the maturity risk by securities salesmen--were shocked when prices plunged as market interest rates spiked (Hummer, 1989, p. 60). Through the end of September 1994, both Ginnie Mae Index and the Lehman Brothers Mortgage-Backed Index were down about 2%, compared with almost 4% for the Lehman Brothers Government Bond Index. Of course, mortgage securities require much more active management. Over the business cycle, they outperform Treasuries. But during heightened volatility, they perform much worse (Osterland, 1994, p. 119).

Because of rapid capital markets developments, the wide use of Mortgage-Backed Securities is in the USA. As Table 2 shows, while the volume of agency mortgage-backed securities was around %15-%20 of U.S. Treasury securities in early 1980's when mortgage-backed securities were first introduced, the volume reached approximately %70-%80 of Treasuries at the end of 2000. Table 3 supports these facts as average daily trading vol-

ume of agency mortgage securities increased by 5 times during the last 10 years.

As Table 4 shows, even it is far behind USA, Europe is increasingly securitizing mortgages in recent years. Of the total \$24,128.5 millions of mortgage-backed securities issuances, nearly % 50 is of UK. However, here in Europe, a secondary market for mortgages has yet to really develop.

The European mortgage market is strong, but the mortgage industry in Europe is highly fractured. Local and national laws and customary business practices have made standardization difficult. Without standardization in product offerings, underwriting criteria and other areas, pooling loans into homogenous pools to create MBS funding instruments presents a challenge (Mozio, 2001, p. 14).

**Table 2. Statistics for MBS and Treasury Securities Markets in the USA**

	Outstanding Volume of Agency Mortgage-Backed Securities (1980 - 2000-- \$ Billions)				Outstanding Volume of U.S. Treasury Securities (1980 - 2000 \$ Billions)
	GNMA	FNMA	FHLMC	Total	Treasury Securities
1980	93.9	-	17.0	110.9	616.4
1981	105.8	0.7	19.9	126.4	683.2
1982	118.9	14.4	43.0	176.3	824.4
1983	159.8	25.1	59.4	244.3	1,024.4
1984	180.0	36.2	73.2	289.4	1,247.4
1985	212.1	55.0	105.0	372.1	1,437.7
1986	262.7	97.2	174.5	534.4	1,619.0
1987	315.8	140.0	216.3	672.1	1,724.7
1988	340.5	178.3	231.1	749.9	1,821.3
1989	369.9	228.2	278.2	876.3	1,945.4
1990	403.6	299.8	321.0	1,024.4	2,195.8
1991	425.3	372.0	363.2	1,160.5	2,471.6
1992	419.5	445.0	409.2	1,273.7	2,754.1
1993	414.1	495.5	440.1	1,349.7	2,989.5
1994	450.9	530.3	460.7	1,441.9	3,126.0
1995	472.3	583.0	515.1	1,570.4	3,307.2
1996	506.2	650.7	554.3	1,711.2	3,459.7
1997	536.8	709.6	579.4	1,825.8	3,456.8
1998	537.4	834.5	646.5	2,018.4	3,355.5
1999	582.0	960.9	749.1	2,292.0	3,281.0
2000	610.5	1,057.8	822.3	2,490.6	2,966.9

Sources: The Bond Market Association, U.S. Treasury, Year 2000

**Table 3. Trading Statistics for MBS Market in the USA**

<b>Average Daily Trading Volume of Agency Mortgage-Related Securities (1991 – 2000--\$ Millions)</b>			
	<b>Transactions w/ Inter-Dealer Brokers</b>	<b>Transactions w/ Others</b>	<b>Total</b>
1991	6,059.0	6,768.0	12,827.0
1992	7,598.0	9,435.0	17,033.0
1993	9,491.0	12,617.0	22,108.0
1994	11,979.0	18,432.0	30,411.0
1995	10,322.0	19,071.0	29,393.0
1996	13,669.0	24,479.0	38,148.0
1997	15,171.0	31,905.0	47,076.0
1998	22,852.0	48,074.0	70,926.0
1999	23,616.0	43,500.0	67,116.0
2000	25,087.0	44,384.0	69,471.0

Source: Federal Reserve Bank of New York, 2000

**Table 4. Statistics for European MBS Market**

<b>European MBS Issuance(1) By Country (All amounts in millions.)</b>				
<b>Country</b>	<b>1/1/99 - 9/30/99</b>		<b>1/1/00 - 9/30/00</b>	
	<b>US\$</b>	<b># Issues</b>	<b>US\$</b>	<b># Issues</b>
Belgium	355.7	1	-	-
Channel Islands	-	-	586.9	2
Germany	-	-	1,701.0	4
Ireland	569.7	4	1,435.8	9
Italy	-	-	2,292.9	16
Netherlands	941.3	11	3,117.9	22
Spain	3,851.9	16	2,028.4	13
Sweden	-	-	-	-
<u>United Kingdom</u>	<u>7,308.3</u>	<u>48</u>	<u>12,965.6</u>	<u>67</u>
Total	13,026.9	80	24,128.5	133

(1) Includes both international and domestic securitised issues, but excludes the German Pfandbriefs.

Source: The Bond Market Association, 2000

## 8. Implications for Emerging Markets

Mortgage-backed securities market has gained a tremendous momentum in developed capital markets, especially in the USA. Mortgage-backed securities are a new concept for emerging markets like Turkey, China, Brazil, etc. Most of these markets still don't have necessary MBS laws and regulations.

Before introducing these securities in emerging markets, several issues has yet to be considered. First, the use of these securities in emerging countries requires a well functioning system for managing mortgage-backed securities. Second, the nature of housing market in those potential countries plays an important role in terms of issuing such securities. Since these securities are based on home mortgages, sufficient volume in housing and thus in mortgages are required for well functioning mortgage-backed securities market.

Third, since mortgage-backed securities are interest rate sensitive instruments, stability in interest rates is also of great importance. In terms of interest rate stability, emerging markets might have some drawbacks. Thus, great amount of risk might be associated with mortgage-backed securities. However, this handicap may be overcome by offering investors attractive alternatives in terms of risk and return through technological sophistication.

Finally, since mortgage-backed securities require much more active management due to their complexity, costs associated with the funds might be high. These costs may even be much higher in developing countries. However, mutual funds, with their low minimums required for investing, high liquidity, convenient recordkeeping, and professional management, could make these securities practical and popular investments for investors, especially for individual investors. Mutual funds may cushion potential risks while providing investors with a diversified portfolio of mortgages with higher yields than Treasury securities and similar credit quality. (T. Rowe Price Associates, 2000, p. 5)

In some emerging markets, some attempts are being made to bring mortgage-backed securities to the market. An Australian firm has been working for two years to launch the first mortgage-backed securitization in China. China still does not have a specific securitization law, so there are some hurdles to be overcome (Davies, 2000, p. 10). A Brazilian company is planning to bring the country's first public residential MBS deal which amounts R\$4.275m (\$2.15m) and is waiting Brazilian SEC approval. (Eurowcek, 2001, p. 53)

## **9. Conclusion**

Mortgage-backed securities are created by pooling individual mortgage loans together and selling them off, in pieces, to investors. In early 1980s,

increased demand and sophistication led to the introduction of various mortgage-backed securities, and during the 1980s, this market has substantially grown.

High return, no default risk, diversification, and promotion of desirable social goals are the factors that make mortgage-backed securities attractive for investors. In spite of these advantages, increased investment in mortgage-backed securities may be inhibited by such considerations as unattractive risk-adjusted returns and complexities of mortgage-backed securities.

The risks associated with mortgage-backed securities include the prepayment risk, contraction risk, and extension risk.

Various types of models are used for pricing mortgage-backed securities, each of which has advantages and disadvantages.

Mortgage-backed security market was the fast growing sector of the capital markets in early 1980s, but was hit hard by the increase in short-term interest rates in the late 1980s.

Mortgage-backed securities usually yields more than Treasury securities. Traditionally, the spread between 10-year mortgage-backed securities and Treasury securities has been about 70 to 100 basis points, but during the trouble period, the spread widened to more than 150 basis points.

Because mortgage instruments are complex and issued in large dominations, the mortgage-backed securities market tends to be dominated by institutional investors. However, individual investors may participate in this market through fixed income mutual funds that invest in mortgage-backed securities.

It seems that mortgage-backed securities market will most likely continue to be fast growing sector of capital markets in the future as long as practitioners offer investors attractive alternatives in terms of risk and return. Technological sophistication seems to help practitioners introduce new attractive alternatives.

Mortgage-backed securities could be used in emerging markets as alternative investment instruments as long as some issues are considered. First, a well functioning system for managing mortgage-backed securities is re-

quired. Second, since these securities are based on home mortgages, the state of housing market and thus, mortgages market have key role on mortgage-backed securities. Third, since mortgage-backed securities are interest rate sensitive instruments, stability in interest rates is also of great importance. Finally, since mortgage-backed securities require much more active management, costs associated with the funds might be high. However, mutual funds that invest in these securities might provide a practical and popular investment alternative for investors.

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