

# Reverse mortgages and HMBS

As the baby boomer generation moves closer to retirement, the proportion of US population over the age of 65 is expected to surge over the next few decades. Many of these senior citizens will have to adjust to curtailed incomes in their retirement years. One financial product that can help supplement their income is a reverse mortgage, which essentially allows homeowners to exchange the equity in their homes for a stream of income. Over the past 10 years, this product has gained a foothold with seniors across the country. It looks to expand further as population demographics continue to shift.

For investors, reverse mortgages provide unique cash flows with limited average life variability. We explore reverse mortgages in detail, with special emphasis on FHA's Home Equity Conversion Mortgage (HECM) program and GNMA HMBS securities.

- While reverse mortgage originations have grown in recent years, changing population trends and increased borrower awareness of the product suggest that origination levels are likely to increase sharply over the coming years.
- With the paralysis of non-agency origination, FHA's HECM program is the dominant producer of reverse mortgage loans. Increasingly, these loans are being securitized into GNMA HMBS pass-throughs.
- In terms of cash flows relative to traditional mortgages, GNMA HMBS provide unique and extremely stable cash flows. This stems from the fact that refinancing risk is extremely limited for these loans, and thus these bonds have essentially no convexity.
- Relative to comparable traditional mortgages, on a nominal spread basis GNMA HMBS trade at similar spreads levels to comparable average life. However, on an option-adjusted basis GNMA HMBS collateral pick up considerable spread to comparable MBS alternatives.

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## Basics of a reverse mortgage

A reverse mortgage is a product targeted at elderly homeowners that has experienced substantial growth over the past decade. It provides a stable source of income to borrowers who have significant equity built up in their homes but have uncertain or limited income streams – in other words, home-rich cash-poor seniors. Unlike a traditional mortgage, the borrowers are not required to make any monthly payments in a reverse mortgage. When the borrower dies or ceases to occupy the house as his primary residence, the proceeds from the sale of the property are used to pay off the loan.

### Basic cash flows and borrower equity growth path

The basic cashflows in a reverse mortgage are quite different from those in a traditional mortgage. We compare the various cash flows over the life of both types of mortgage in Figure 1.

The cash flow at initiation of the contract is similar in both cases. There is a transfer of funds from the lender to the borrower. The difference lies in the size of the transfer. In the case of a traditional mortgage, the entire borrowed amount is transferred to the borrower at initiation. In a reverse mortgage, funds are transferred to the borrower as well; however, there are several common payment options available. In an upfront lump sum, the entire borrowed amount is transferred at initiation. In the case of a simple line of credit, no funds are transferred. We discuss different types of payment options later in this report.

**Figure 1: Basic cash flows over the life of a mortgage**

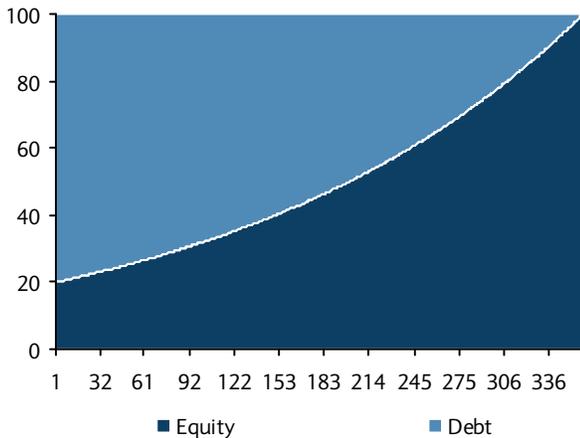
	Initiation	Lifetime	Termination
Traditional Mortgage	Lender to Borrower	Borrower to lender (monthly)	None, borrower owns house
Reverse Mortgage	Lender to Borrower	Accrued interest is added to principal balance	Borrower to lender with proceeds from sale of house

Source: Barclays Capital

The main difference lies in how principal and interest are repaid by the borrower. For a traditional mortgage, the borrower makes monthly principal and interest payments against the borrowed amount. With a reverse mortgage, interest accrued on the borrowed amount is added to the principal of the loan. A reverse mortgage contract is deemed to have ended when the underlying property is no longer the borrower’s primary residence, either due to mortality or other causes. At this point, the borrower or his designated estate pays back the accumulated amount to the lender, usually using the proceeds from the sale of the property. The amount paid back is the minimum of the amount owed to the lender and the proceeds from the sale.

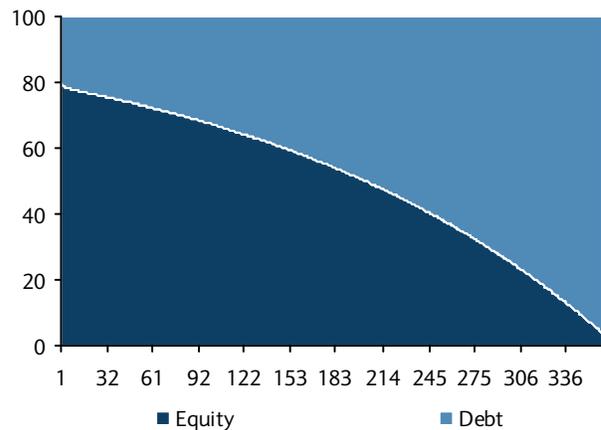
As can be inferred from the cash flow patterns just described, evolution of a borrower’s equity stake in the underlying property also follows different paths for the two types of mortgages. In a traditional mortgage, the borrower has a small equity position at the start on account of the down payment (Figure 2). The remaining is debt held by the lender. As the borrower makes monthly P&I payments over time, his equity position improves and debt is paid down. At the end of the contract, all debt is paid down and the borrower owns 100% equity in the property.

Figure 2: Debt-equity position of borrower in a traditional mortgage



Source: Barclays Capital

Figure 3: Debt-equity position of a borrower in a reverse mortgage



Source: Barclays Capital

In a reverse mortgage, the borrower starts with significant equity stake in the property and a relatively small debt position (Figure 3). Over time, as the borrower receives payments from the lender and interest accrues on the debt, the equity position is slowly eroded. By the end of the contract (most commonly due to death of the borrower), the borrower’s equity has almost been entirely eroded. As per the terms of the most common reverse mortgages, it is also possible for the debt outstanding to exceed the value of the property if home prices fall significantly, interest rates remain higher than expected at the time of initiation and/or the borrower lives for longer than average. We discuss each of these factors later in this report. The key takeaway from these charts is that in a reverse mortgage, a borrower extracts built-up equity in a home. In that respect it is not very different from a HELOC (home equity line of credit). The difference arises in the underwriting standards, lending limits, program structure and the fact that a reverse mortgage has no fixed tenure. Also, the borrower’s liability is limited to whatever equity he holds in the property.

### Outlook for reverse mortgage originations

The Home Equity Conversion Mortgage (HECM) program was launched in 1987 by the Department of Housing and Urban Development. This is a federal reverse mortgage program and was launched to provide an opportunity to senior citizens to take advantage of their built-up home equity. The loans are fully guaranteed by the US government. Few borrowers utilized the program over the first decade. Through the 1990s, the annual number of reverse mortgage taken out remained small (Figure 4). However, the pace of originations picked up by 2000 and has been increasing ever since. Greater awareness about the product has helped increase the rate of origination.

We expect strong growth in this product. From the demand side, demographics remain very favourable. The US population is aging rapidly and the number of eligible borrowers is set to increase sharply as the baby boomers retire (Figure 5) and life expectancy continues to increase. As per projections from the Census Bureau, there will be an estimated 85mn seniors above the age of 62 by 2025 and 112mn by 2050. As knowledge about the product increases, it is clear that there will be more demand for reverse mortgages. Potential changes to the tax code – such as high estate taxes – can also play a role in pushing seniors toward cashing out on their equity sooner.

The supply picture is more uncertain as this market is almost exclusively dominated by government-backed issuance currently. Absence of widespread information on this product

has led to a limited, albeit dedicated investor base. However, that picture is likely to change as this is a very stable and attractive product. With significant growth opportunities, it is likely that this sector will continue to see greater investor interest.

## Home Equity Conversion Mortgage (HECM) program

Reverse mortgages come in many forms and flavours with private as well as government-backed issuance. However, HUD’s HECM program controls a large portion of the overall reverse mortgage market. Congress created the program in 1989 and appointed the Department of Housing and Urban Development (HUD) as the administrator. Private origination has been a small sliver of the market, and after the credit crisis of 2008, it has been completely shut down. The Fannie Mae Home Keeper program also constitutes a small part of the market.

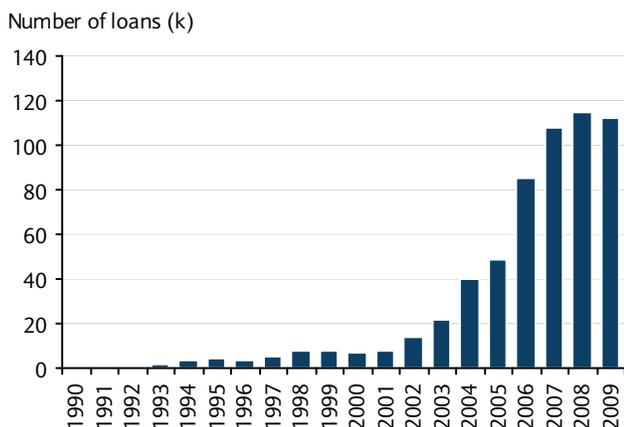
We will focus on the HECM program. The following sections discuss the features and characteristics of HECM loans.

### Eligibility

There are specific HUD guidelines on eligibility for HECM loans that we will discuss below. Do note, though, that none of these address the credit quality of the borrower. This is one of the main features of the program that allows borrowers with weak credit histories or low income to cash out on built-up home equity.

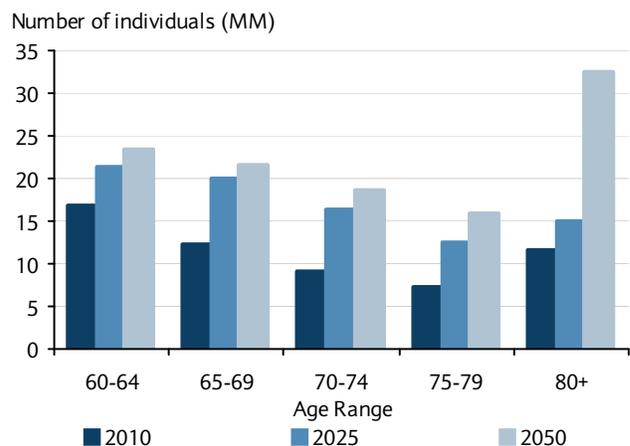
- *Age:* Borrower and any co-borrower must be at least 62 years old at origination.
- *Other debt:* Borrower must own significant equity in the property in the home. Any other debt against the home must be paid off or be small enough to be payable from the proceeds of the reverse mortgage. Borrowers should also not be delinquent on any federal loan.
- *Property type:* The property should be a single family home or a single unit in a 1-4 unit home. HUD-approved condos and certain manufactured homes are also eligible. The property must be the legal primary residence of the borrower.

Figure 4: Origination volumes for reverse mortgages over the years



Source: HUD, Barclays Capital

Figure 5: US 60+ population distribution over time



Source: US Census Bureau, Barclays Capital

## Interest rates

Borrowers can choose from different available interest rate options for the reverse mortgage. Both fixed and variable rate options are offered. The variable rates are a function of the 1y CMT and can reset annually or monthly. Data show that the 1y CMT rate resetting monthly is by far the most popular choice for most borrowers, though there has been some decline in its popularity of late (Figure 6). Almost all HECM borrowers up until 2008 chose this rate type on their mortgage. However, for the 2009 vintage, there has been a sharp increase in the number of fixed rate loans and almost 20% of the loans endorsed to date had a fixed rate.

There are caps built into some of the adjustable rates. The annually adjusting rate cannot be adjusted by more than 2% each year and by more than 5% over the life of the loan. There is a 10% lifetime cap in the monthly resetting loans.

## Other fees

- *Origination fee and closing costs:* Origination fee paid to lender at the rate of 2% for the first \$200k or appraised home value and 1% for the amount above that, subject to a minimum of \$2,500 and a maximum of \$6,000. Closing costs include costs for appraisal, title search, and inspections. These costs can be rolled into the loan.
- *Mortgage Insurance Premium (MIP):* This is paid to HUD and the upfront cost is 2% of the lesser of the local FHA loan limit and the property's appraised value. This can be rolled into the loan. An annualized MIP equal to 50bp of the mortgage balance is also charged monthly for the life of the loan. It is accrued onto the outstanding loan balance.
- *Servicing fee:* Servicing fees are capped at \$30 for an annually resetting interest rate and \$35 for a monthly resetting rate. The initial servicing fee is deducted from the proceeds of the loan. For every subsequent month, the fee is added to the loan balance.

## Payment options

Borrowers can choose to draw down the loan in one of four ways

- *Tenure:* Equal monthly payments for the life of the loan
- *Term:* Equal monthly payments for a fixed period of time
- *Modified tenure/tenure:* A line of credit along with fixed equal monthly payments either for the life of the loan or for a fixed time period
- *Line of credit:* An initial line that can be drawn down at any rate anytime

Data show that the last option mentioned above is the most popular choice with more than 82% of borrowers opting for it (Figure 7). Borrowers typically tend to draw down on most of the line very early into the reverse mortgage. We discuss this in more detail in the section on drawdowns.

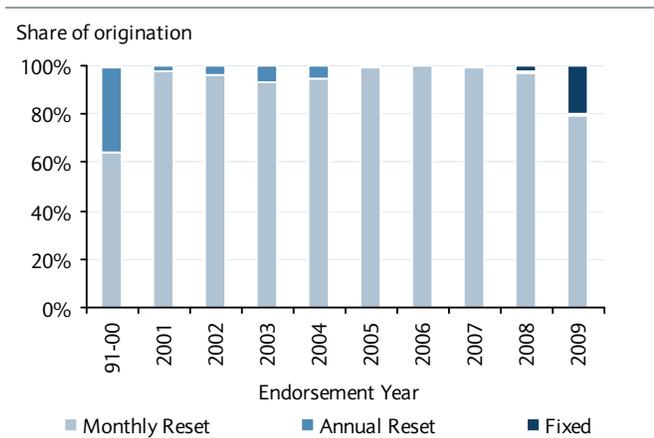
## Size of mortgage

There are two related terms that define the size of a reverse mortgage:

### *Maximum claim amount*

This denotes the value of the underlying asset and is calculated as the minimum of the currently appraised value of the property and the local FHA loan limits. This number is the starting point for calculation of the principal limit.

Figure 6: Distribution of interest rate types for HECM



Source: HUD, Barclays Capital

Figure 7: Distribution of payment options for HECM borrowers

Prepayment option	Share of origination
Tenure	4%
Term	2%
LOC + Tenure/Term	12%
Line of Credit	82%

Source: HUD, Barclays Capital

*Initial principal limit*

This is the maximum amount of money that can be initially withdrawn by the borrower. Starting from the maximum claim amount, the initial principal limit is calculated assuming a certain forward rate path, borrower life expectancy and an assumed profitability margin.

*How is principal limit calculated?*

Initial principal limit is calculated by discounting the maximum claim amount by the average expected interest rate over a time period reflective of the average remaining life of a borrower. We show an example here. Note: This is only illustrative, actual HUD calculations and assumptions may be different. To calculate an initial principal limit based on different parameters, please see the AARP reverse mortgage calculator.

Property appraisal: \$200,000	Geographical FHA limit: \$250,000
Maximum claim amount: \$200,000	
Age of youngest borrower: 67 years	Gender of youngest borrower: Male
10 year swap rate: 3.75%	Assumed margin: 200bp
Assumed MIP: 50bp	Servicing fee: 10bp
Total WAC = 6.35%	
Factor for 6.35% interest rate and 67 years from HUD table = 0.518	
Initial Principal Limit: \$200,000 * 0.518 = 103,600	

The following factors influence the calculation of initial principal limit on a HECM loan.

- **Borrower age:** The expected remaining lifetime of an older borrower is lower, thus reducing the number of years for which the loan will remain unpaid and accrue interest. Therefore, the principal limits for an older borrower tend to be higher as compared to a younger borrower, assuming same maximum claim amount.
- **Borrower gender:** Actuarial studies show that female life expectancy is higher than male life expectancy. Therefore, initial principal limits for women tend to be lower than for men, all else being equal.

- *Geography:* Areas with higher FHA loan limits will likely have higher maximum claim amounts. As a result, the initial principal limit will also be higher than a low FHA loan limit area.
- *Prevailing interest rates:* The principal limit is a function of the “expected interest rate,” which is calculated from prevailing rates. In a high rate environment, the expected rates will be higher, and hence the initial principal limit will fall. The reverse will occur in a low rate environment where the low prevailing rates will result in a higher calculated principal limit. For adjustable rate loans, the expected rate used is the 10y swap rate plus a margin.

## Loan repayment

An HECM loan does not have a fixed term, unlike traditional mortgages. Loan repayment is mostly triggered once the borrower dies or moves out of his primary residence. Prepayments analogous to those in traditional mortgages are also possible but very rare. The main types of loan repayment are listed below.

### *Mortality*

The death of the borrower triggers the repayment of the loan. The outstanding loan is paid off from the proceeds obtained by selling off the property, or by the deceased borrower’s estate. This is the largest source of repayments for the reverse mortgage universe accounting for about 80% of the overall repayments (Figure 8).

### *Mobility*

When the borrower moves from the property backing the reverse mortgage and it ceases being the legal primary residence, the loan becomes due in full. For the demographics that this program targets, mobility comes not only from standard turnover (moving to a different house) but also from borrowers moving to nursing homes or other managed care. This is the second largest source of repayments (Figure 8).

### *Other minor causes*

- *Foreclosure:* Under the terms of the agreement, the borrower is required to maintain the property to certain minimum standards and pay all taxes in time. When the borrower fails to satisfy terms, foreclosure proceedings can be initiated to pay off the drawn upon loan. About 2% of repayments fall under this category.
- *Voluntary assignment:* A lender can assign an HECM loan to HUD when the loan balance crosses certain LTV thresholds due to negative amortization. About 3% of the repayments to date fall under this category.
- *Refinancing:* If a borrower gets more attractive terms due to lower prevailing rates and/or better home valuation, then he may have incentive to pay off the existing reverse mortgage using the proceeds from a new loan. Although, high upfront costs tend to dampen this dynamic to a large extent.

## Getting to know the HECM borrower

### *Age*

The average age of borrowers taking out reverse mortgages has decreased steadily since the launch of the program (Figure 9). We attribute this shift to greater awareness of the product. This trend bodes well for future HECM origination as significant inflow is expected into the 62+ bucket in the near future.

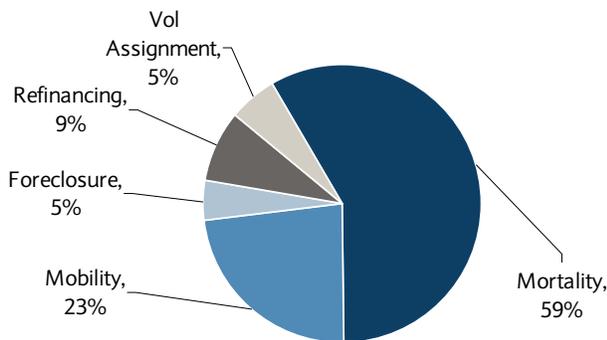
*Gender*

Loans with females as the primary borrowers accounted for more than 50% of all the reverse mortgage loans. Co-signed loans come next, followed by male-only loans. However, this statistic has also shifted over time with more men and couples taking out reverse mortgages today than they did earlier (Figure 10).

*Geographical distribution*

Trends in geographical concentration of HECM loans have changed significantly over time. At the start, most of these loans were originated in California and New York, though New York's share was higher than its share in traditional agency mortgages. In the middle of this decade, the share of California HECMs shot up (Figure 11). We attribute this to greater product recognition in that area. However, once HECM origination started cranking up in 2006-07, the share of Florida loans rose sharply. This does not come as a surprise given Florida's well known reputation of being retiree-friendly. However, the subsequent bust saw Florida's share go down again and home values suffered significantly. There was a pickup in concentration of HECM loans in Texas and New York – two states that weathered the housing downturn much better than others.

**Figure 8: Types of repayment on HECM loans**



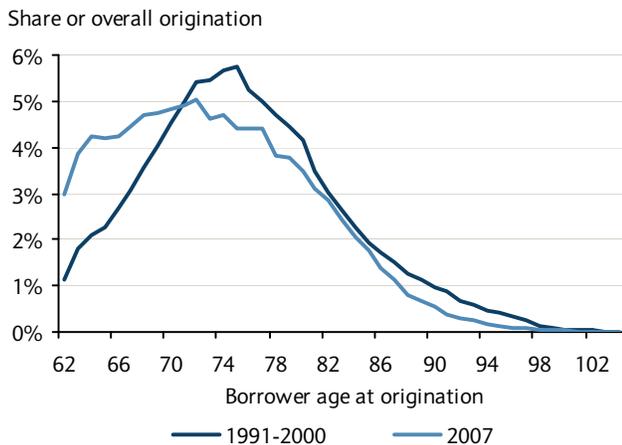
Source: HUD, Barclays Capital

**Figure 9: Gender distribution for HECM borrowers**

	1991-2000	2007
Single Male	14%	18%
Single Female	56%	45%
Couple	30%	37%

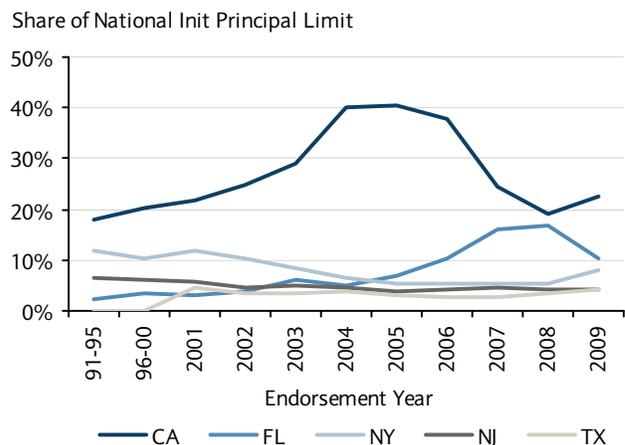
Source: HUD, Barclays Capital

**Figure 10: Age distribution for HECM borrowers**



Source: HUD, Barclays Capital

**Figure 11: Geographical distribution for HECM borrowers**



Source: HUD, Barclays Capital

## Repayment and drawdown behaviour

As we mentioned above, the majority of HECM loans are taken out in the form of a line of credit. Most of the amount is drawn out upfront and the remaining is drawn out over the life of the loan. As such, repayment and draw behavior are the most important parameters for valuation of HECM loans and securities. In this section, we examine past data on repayments and draws based on reverse mortgages originated by HUD between 1989 and 2007. Based on this data, we will build our expectations for the parameters in the next section.

### Repayment behavior

As mortality and mobility make up most of the explained prepays, they are likely to dictate repayment behavior, and we will focus on them.

#### *Mortality*

The leading cause of repayment is death of the borrower. Mortality is a function of two characteristics – gender and age.

Age is the most important factor determining mortality. As a person grows older, the probability of mortality-related repayment increases. Though mortality increased rapidly in the early decades of the 20th century, the pace of increase has slowed down significantly and trends have become more stable. Mortality rates are not prone to fluctuation and thus repayments due to this factor can be projected with a fair degree of certainty. This characteristic imparts the stable repayment characteristic to reverse mortgages that makes the product very attractive from an investment standpoint.

Gender is also a determinant of mortality as females typically have higher life expectancy than males. Pools with higher concentrations of female borrowers can therefore be expected to have higher average life, all else being equal.

#### *Mobility*

Some mobility is always present within a population due to unexpected changes in needs or circumstances, analogous to turnover in standard mortgages. Typically, causes include relocation due to personal or financial reasons or into a bigger house. However, for the demographic under consideration, mobility also ends up correlating significantly with mortality due to their particular circumstances. As borrowers get older, many end up moving to nursing homes or other managed care facilities. Such a move triggers the primary residence clause in the mortgage and the loan becomes due. This correlation with age makes mobility trends fairly stable, due to the same reasons outlined for mortality.

### Empirical prepay data suggest little refinancing activity

In order to gather some insight into the repayment behaviour for HECM loans, we looked at a sample of 480k reverse mortgage loans endorsed by HUD between 1989 and 2007. These data cover more than 85% of the entire reverse mortgage market and are a very good representation of the trends in this space.

#### *Prepays by loan age and vintage*

Figure 12 shows the repayment rate on HECM loans across vintages along loan age. The stable repayment trends seen across vintages – despite that loans were originated and serviced across very different macroeconomic environments – are striking indeed. This goes back to our earlier point on stability of mortality trends. Given that almost all the repayments can be attributed to mortality and mobility, trends remain independent of the broader housing and interest rate environment.

*Will prepayments always remain this stable?*

Prepayment trends for HECM reverse mortgages have been very stable over time. However, the key question in the minds of any new investor in this space is most likely: will this trend hold? We believe that it is unlikely that prepayments will deviate significantly from historical trends due to four reasons.

1. Prepayments have historically been mostly a function of mortality. Given that mortality does not fluctuate significantly over a large timeframe, prepayments attributable to mortality are likely to remain stable.
2. High origination costs tend to widen the rate incentive required to make the refinancing economic. Origination fees tend to range between 3 and 4% of total claim amount, which can be 5-8% of the initial principal limit. That can be a significant disincentive for opportunistic refinancing.
3. The only objective of a borrower in refinancing the reverse mortgage would be to extract more equity given lower prevailing mortgage rates. However, the rate for calculation of initial principal limit is floored at 5.5%<sup>1</sup>. Therefore, significant rate rallies are unlikely to affect the initial principal limit by much – especially when initial loans are originated in low rate environments such as the present one.
4. Finally, elderly borrowers are also not very efficient at exercising the refinancing option, thus leading to muted prepayment even in the face of some refinancing incentive.

*A note on fixed rate HECM prepayments*

As shown in Figure 6, most of the HECM origination to date has variable interest rates. Hence, most of the observed prepayment data is based on variable rate reverse mortgages. Given the rise in issuance of fixed rate loans recently, a valid question may be raised on the applicability of conclusions drawn on the basis of this data on prepayments of fixed rate loans. We believe that fixed rate loans will exhibit prepayment behaviour similar to that of variable rate loans.

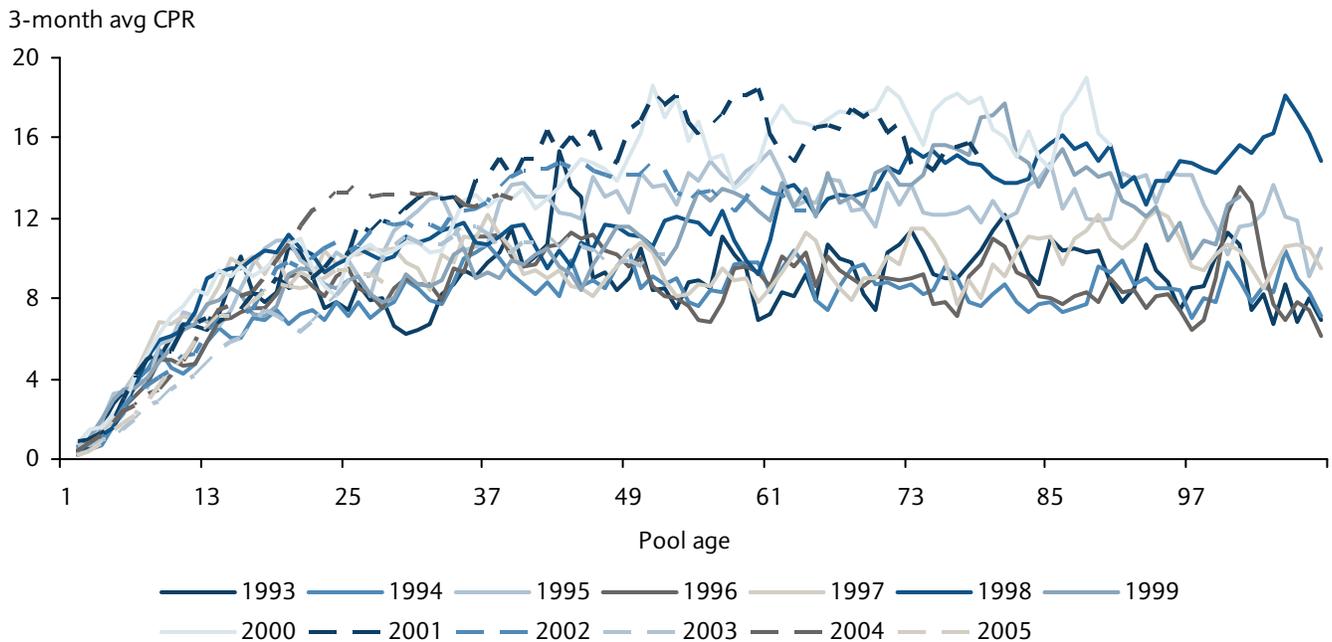
Given that there is no monthly payment to be made in reverse mortgages, the main aim of a borrower is to withdraw more cash against the home. The initial principal limit depends on the average expected interest rate. For an adjustable rate loan, the 10y swap rate is used as the index for the average expected rate. Within certain bounds, the long-end swap rate can be assumed to behave similarly to the fixed rate used to calculate the initial principal limit. This allows us to translate prepayment history for variable rate loans into expectations for fixed rate loans.

Thus, we do not believe that fixed rate prepayments will differ significantly from historical ARM prepayments. The reasons that lead to muted ARM prepayments (described in the preceding section) apply equally to fixed rate loans.

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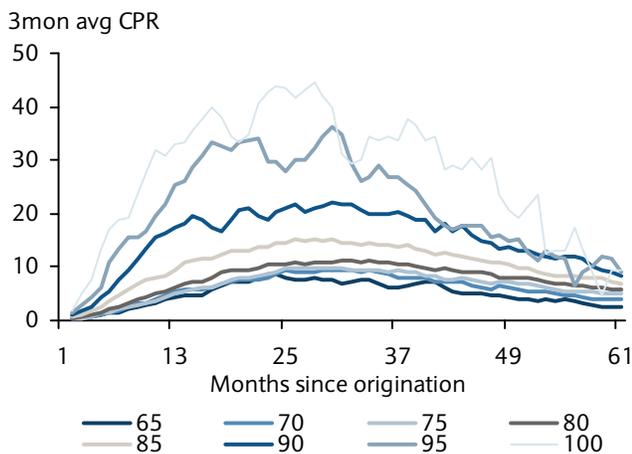
<sup>1</sup> HUD Mortgagee Letter 2004-18

Figure 12: Non-claim terminations (prepays) by vintage



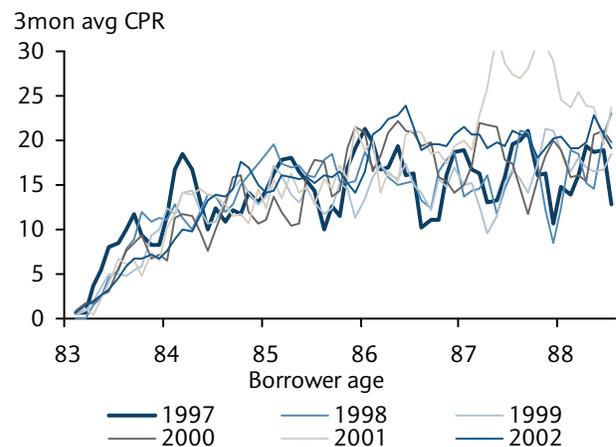
Source: HUD, Barclays Capital

Figure 13: Non-claim terminations for different borrower age buckets over time



Source: HUD, Barclays Capital

Figure 14: Non-claim terminations over time controlled for borrower age



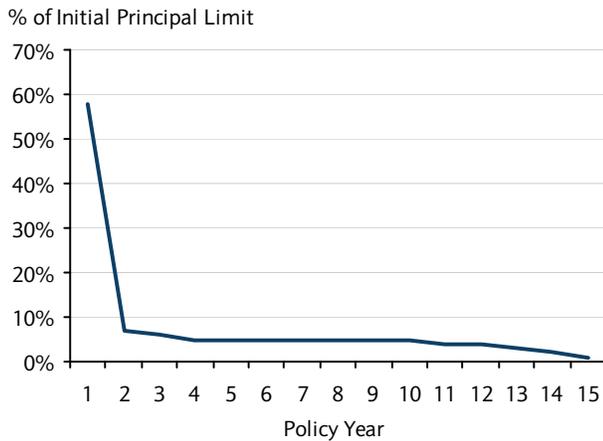
Source: HUD, Barclays Capital

### Drawdown behaviour

We show historical drawdown behaviour of HECM pools in Figure 15. Typically, there is a sharp drawdown spike in the first month and then the rate settles at a much lower steady number for the rest of the life of the pool. However, the drawdown behaviour of recent fixed rate reverse mortgage originations has been quite different. As a term of the low fixed rate, borrowers were required to draw down upon the entire balance upfront. As a result, there is no possibility of future draws on these loans.

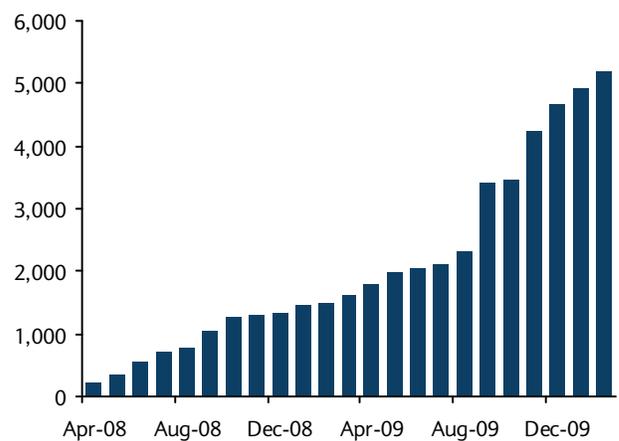
We feel it is important to mention that drawdowns do not directly affect repayment of HECM loans. However, loans get bought out of HMBS pools once they hit the 98 LTV cap, and hence drawdowns end up altering HMBS repayments. We discuss this in more detail in the next section.

Figure 15: Drawdown rates on HECM pools



Source: HUD, Barclays Capital

Figure 16: Cumulative HMBS Issuance (\$mn)



Source: HUD, Barclays Capital

## HECM Backed Mortgage Securities (HMBS)

Though HECM loans constitute a disproportionate portion of the reverse mortgage market, HECM loans were slow to be securitized or traded actively in the secondary market. On the other hand, private reverse mortgage securities have been around since 1999.

Difficulty in managing two directional cash flows (drawdowns from investor to borrower and repayments from borrower to investor) as well as limited investor appetite to hold non-cash flowing accrual securities hampered development of an active secondary market. The first HECM mortgage backed security (HMBS) was issued in 2006. In the past two years more than \$5bn of HMBS has been issued (Figure 16). Given the rapid increase in HECM loan endorsements, it is likely that issuance will increase in the future. In the following sections we discuss the mechanics of HMBS.

### Basic structure of security

A pool of HECM loans with outstanding balances is used to create an HMBS. Beyond this point, investors in this pool are not responsible for any additional draws. The incremental drawn-out balance is securitized separately and sold as separate securities. This handles the problem of two directional flows between investors in a security and underlying borrowers and simplifies the structure significantly.

### Coupon

The securities are structured as WAC passthroughs, and the coupon on the securities is simply a weighted average value of the interest rates on the underlying loans less the servicing fee and guarantee fee. These securities do not pay out any monthly coupon; it is amortized back into the loan balance instead. The monthly guarantee fee and servicing fee are also added to the security balance.

### G-fee and servicing fee

Issuers pay a monthly guarantee-fee of 6bp annualized on the outstanding HMBS to Ginnie Mae, which is amortized into the HMBS balance. The servicer charges a monthly servicing fee that is either flat at \$30-35 or variable at 19-69bp annualized on the HECM balance. The pro-rated share of this attributable to the HMBS (using balance of HECM that is securitized under the specific HMBS) is added back to the HMBS balance.

### *Stated maturity*

There is no stated maturity on an HECM loan, and thus stated maturity of HMBS is undefined. However, to ease book-entry requirements, stated maturity is assumed to be 100 years from date of HMBS origination.

### *Pool parameters*

Minimum pool size is \$1mn. HECM loans underlying an HMBS must have similar interest rate type with the same reset date and same index. They can, however, have different payment options.

### **Paydowns in HMBS**

HMBS get paid down when the HECM loans repay due to mortality, mobility or other factors. Once repayment is triggered, the funds equal to the minimum of accrued balance of the HECM or proceeds from sale of the property are owed to the trust. Given that the security is guaranteed by the full faith of the US government, any shortfall from the outstanding balance is covered by Ginnie Mae. Please note that only the pro-rated share of balance that was securitized with this trust is paid back.

### *Buyouts*

An interesting feature of HMBS is the LTV based buyout. If the LTV on a HECM loan exceeds 98%, then the loan is either assigned to FHA or repurchased by Ginnie Mae from the HMBS. This tends to extend greater cash flow predictability to HMBS investors in the event that realized interest rates turn out to be much higher than expected at origination or life expectancy unexpectedly increases. In our analysis, it significantly affects cash flow patterns and tends to shorten the average life of the security.

## **Modelling HECM and HMBS**

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### **Forecasting mortality, mobility and drawdown rates**

We forecast these vectors based on historical data and expectations on key drivers discussed earlier.

- **Mortality:** Forecasting mortality is fairly straightforward. We use the life expectancy tables published by the US Census Bureau. We incorporate the difference in life expectancy for the two genders into the model (Figure 17). Assuming that most of the prepaids are attributable to mortality, we model mobility as the residual left over after mortality has been accounted for. However, actual data seem to suggest a high residual after accounting for mortality. There also seems to be a ramp-up in the initial months, which cannot be explained by mortality (Figure 18).

Research has shown <sup>2</sup> that the average mortality of HECM borrowers is higher than the average population. Even HUD's initial principal limit calculation assumes higher mortality than average (1.3x). This is due to the fact that many times some illness or medical condition of the borrower triggers taking out a reverse mortgage. It therefore follows that this borrower pool experiences higher mortality. Our analysis suggests a higher multiple than the 1.3x used by HUD. We use a 1.6x multiple for our model.

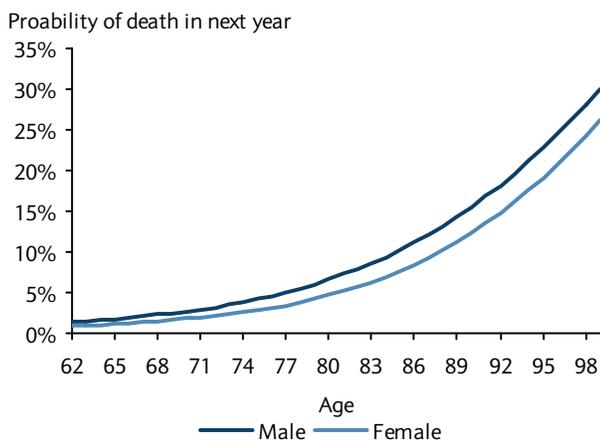
The initial ramp can be explained by underwriting standards. It is unlikely that a borrower near death is in a position to go through the process of taking out a reverse mortgage. Thus, the mortality rate over the first few months of a pool does not reflect the statistical mortality of the borrowers. We therefore use an 18-month ramp before switching to pure statistical mortality expectations.

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<sup>2</sup> "Reversing the Trend: The recent expansion of the reverse mortgage market," Hui Shan, Federal Reserve Board, 2009

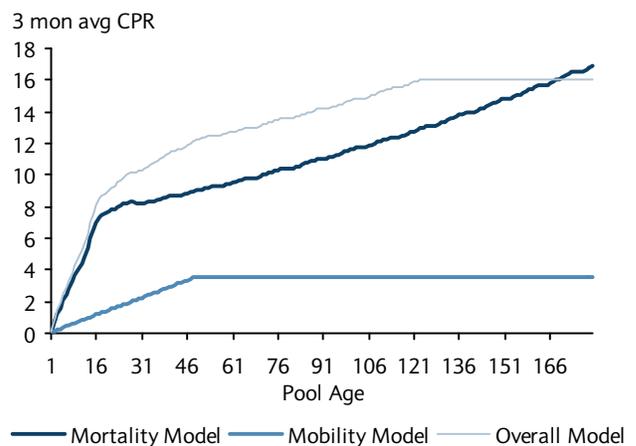
- **Mobility:** Though there are no direct data available on mobility, we can impute it from the overall prepayment data. Given that there is a fair degree of certainty around mortality-related prepayments, the residual non-claim terminations seen in pools can be attributed to mobility. We show the residual component in Figure 18. We assume a ramp on mobility over the first 48 months, assuming that the older and physically weaker borrowers moved out of their homes. Beyond that, we assume constant mobility as mortality dominates at that point.
- **Long-term cap:** We also set long-term overall prepayments to 16 CPR. Historical prepayment trends suggest that the long-term overall prepay rate has mostly never exceeded this value (Figure 12). This is slightly counterintuitive as empirical mortality trends would suggest that the prepay rate should forever keep increasing as the pools age. We believe that due to positive selection, only the healthier and younger borrowers are left behind in the pool (with weaker borrowers having moved out through a combination of mobility and mortality). Thus, the prepayment rate flattens after rising six to seven years.
- **Drawdowns:** Though we have no ready access to drawdown data, based on our discussion with HECM experts and other research, we expect drawdowns to follow the pattern shown in Figure 15. For analyzing fixed rate loans, we will use no draws, assuming that the total balance has been drawn down at the start. We discussed the reason for this in the section on drawdowns above.
- **Claim terminations:** Claim terminations can be of two types:
  - **Assignments:** This usually occurs when the loan hits certain LTV caps and is therefore assigned to HUD. We do not model this as a separate vector but handle it within the cashflows of the individual loans.
  - **Loss terminations:** Occurs in case of foreclosure on a borrower (due to significant non-maintenance) or an unsuccessful mortgagor's sale. The occurrence of these terminations is very rare (<4%) and hence we will not model them separately.

Figure 17: Mortality by age



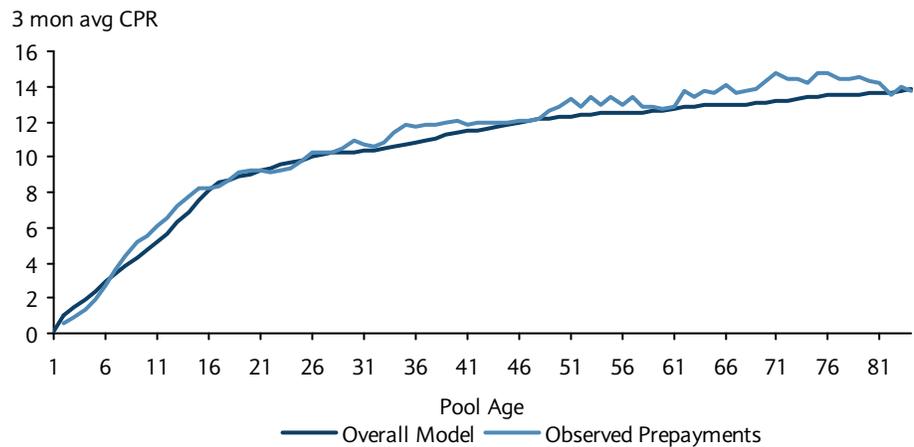
Source: Census Bureau, Barclays Capital

Figure 18: Mortality, mobility and overall model



Source: HUD, Barclays Capital

Figure 19: Prepayment model vs observed



Source: HUD, Barclays Capital

### Cashflows

We now present cashflows obtained by running the above assumptions on a fixed rate HECM pool consisting of 930 loans originated in 2009 and 2010. The overall characteristics of the pool are shown in Figure 20. We modelled mortality on individual loans using a probability-weighted function. Given the large pool size, the results are stable across runs.

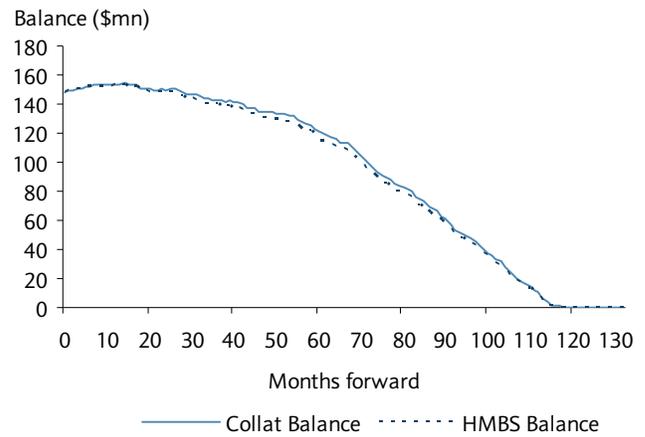
- **Base case collateral balance versus HMBS balance:** As this is a completely drawn down fixed rate pool, there is very little difference between the collateral and HMBS balance profile (Figure 21). The collateral balance tends to be slightly higher on account of the higher coupon (servicing fee and g-fee is not passed onto the HMBS bond). It is noteworthy that the collateral and the bonds both have average lives of 6.8 years, despite an effectively perpetual underlying loan.
- **Prepays:** The overall prepayment rate is shown in Figure 22. At first glance, the high prepayment rate may seem a little shocking. After all, we had assumed a cap of 16 CPR on lifetime prepayments. However, one has to model in the effect of the LTV cap based buyout. As discussed in the HMBS section above, FHA buys out all loans that exceed 98 LTV due to accrual of interest and other costs. This leads to much faster overall prepayments as compared with just mortality- and mobility-related prepayments. Figure 23 shows prepayments assuming no buyouts. As expected, those prepayment rates remain quite low.

Figure 20: Collateral characteristics of sample pool

Maximum claim amount	252,573
Initial principal limit	163,702
LTV	65%
Borrower age	73.1
Number of loans	930
Average WAC	5.56

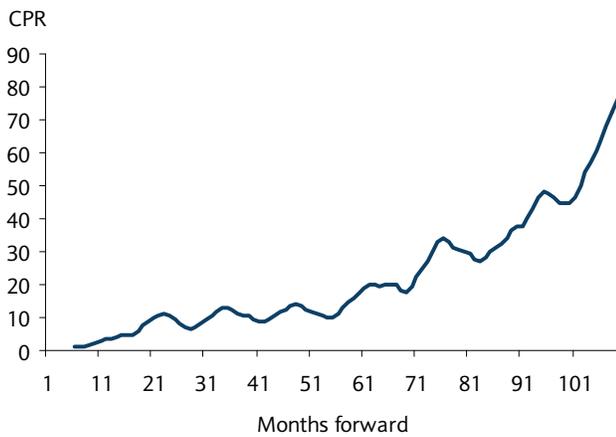
Source: Barclays Capital

Figure 21: Collateral and HMBS balance over time



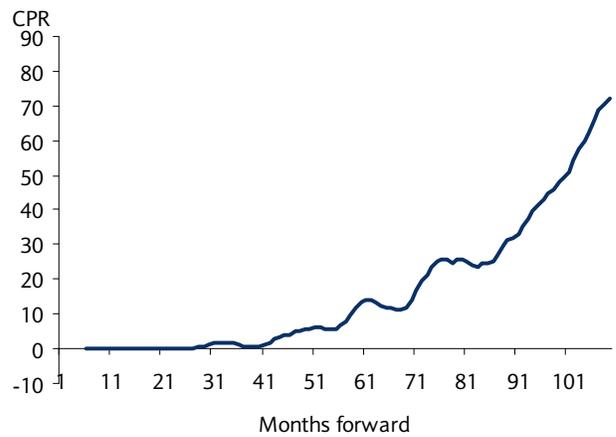
Source: Barclays Capital

Figure 22: Overall collateral prepayment



Source: Barclays Capital

Figure 23: Collateral prepayment without buyouts



Source: Barclays Capital

- Average life sensitivity to prepayments look to be rather small:** We check the average life sensitivity of HMBS to the mortality multiple assumptions for HECM borrowers and find that the results do not change significantly with that assumption. The average life of the collateral pool remains within a reasonable range, even over a wide range of multiples (Figure 24). Most of this is a result of the fact that buyout-related prepayments are expected to be much higher than mortality- or mobility-related prepayments. As a result, changes in mortality assumptions do not alter the outcome significantly.

This can be attributed to the initial principal limit not being set using appropriate life expectancies. If the life expectancy used in the calculation were spot on, then the borrower would die before the loan hit the LTV cap. Thus, there would be very few buyouts. The fact that it is not so reflects that higher life expectancy is being used than what data show. This works out to be in favour of the investor, as one would prefer a guaranteed and predictable prepayment event (HUD buyout) over a relatively less predictable event (mortality).

Figure 24: Sensitivity of average collateral life to mortality multiple

Mortality multiple	Average collateral life
1.0	7.0
1.3	6.9
1.6	6.8
1.9	6.7
2.2	6.6

Source: Barclays Capital

## Relative value analysis

Given the unique nature of HMBS securities – accrual securities with a fairly range bound average life – there are relatively few securities that they can be compared with. In the mortgage space some reasonable comparisons can be made with GNMA 15 collateral and intermediate PACs off of GNMA collateral. We believe that the securities show in Figure 25 come closest in terms of cash flows, and we evaluate the relative value of HMBS against each of these.

Figure 25: Relative value analysis of HMBS with comparable assets

	Coupon	Price	I-Spd	OAS	AL	AL +200	AL -200	Yield
HMBS Pass-thru	5.5%	109-25	82	89	6.9	6.9	6.9	3.99
15y GNMA PT	4%	103-2	85	12	4.5	5.2	2.8	3.21
GNMA PAC 5/5	5%	106-5	83	33	6.6	8.7	1.8	3.93

Source: Barclays Capital

A couple of things stand out in this analysis. First, on a nominal spread basis, all the bonds that we considered pick up about 80-85bp relative to Treasuries. However, the key difference arises when we examine option-adjusted spreads for HMBS pass-throughs relative to 15y GNMA and the 5/5 GNMA PAC. As the HMBS have no negative convexity to speak of, they pick up 89bp of OAS to Treasuries, a pick of 50-70bp to the other bonds that we have considered. This difference is also displayed in the average life sensitivity of these other bonds. While HMBS pools maintain a stable average life, even with large changes in interest rates, the 15y GNMA and 5/5 GNMA PACs are subject to considerable average life variability in these scenarios.

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