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COLLATERALIZED MORTGAGE OBLIGATIONS

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Panelists: MARK R. HANCOCK*
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Recorder: RONALD JAY RUBNICH

- Definition
- Characteristics of a Collateralized Mortgage Obligation (CMO) issue
  - Tranches
  - Z Bonds
  - Planned Amortization Classes (PACs)
  - Targeted Amortization Classes (TACs), etc.
- Underlying assumptions
  - Prepayments
  - Safety
- Modeling of these securities for pricing and projection purposes
- Dynamic performance characteristics of CMO classes

MR. D. ANDREW HALL III: This topic, CMOs, has been the subject of numerous 3-4 day conferences. We're going to try to cover it here in a short session, so I'm going to make it very brief with the introductions.

The first one to speak will be George Michael. George is a Vice-President at Salomon Brothers where he sits on the mortgage trading desk and actually structures the CMOs. George is an Associate of the Society of Actuaries who took his actuarial knowledge into mortgages, which a number of us have done. He'll be talking about the nuts and bolts, the basic definition of what a CMO is.

After that we're going to have a tag team from Axe-Houghton, David Moore and Joe Sindelar. David and Joe work together and are both Assistant Vice-Presidents. David is the head of the Asset Allocation and Asset Liability area in the Baltimore office. Joe is the head of the Fixed Income Portfolio Management Department also at the Baltimore office. Joe's area is responsible for MBSs (Mortgage Backed Securities), private placements, and government and municipal bonds. Joe personally manages the mortgage-backed and CMO areas.

The last speaker will be Mark Hancock, an Associate at Morgan Stanley. He will be talking about some of the dynamic performance characteristics of CMOs, and how the different tranches in the CMO interact with one another.

MR. GEORGE A. MICHAEL: I'd like to speak to you about the basics of CMOs, giving you an overview of how the cash flows work and some characteristics of typical bonds. I'm going to start from the beginning, so please bear with me if you're familiar with the material.

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PANEL DISCUSSION

A CMO is a multi-class debt instrument, collateralized by a pool of mortgages where the cash flow given off by the mortgage is rearranged to pay bonds. The bonds are totally collateralized so that there's virtually no credit risk.

How does all this work? Here we have a basic level-pay mortgage diagram with very little principal being paid up front and quite a bit being paid towards the end (Graph 1). If this was all there were to mortgages, there wouldn't be much for me to talk about. However, mortgages have an interesting characteristic, that is prepayments. Prepayment occurs when a mortgage holder pays off his mortgage prior to its maturity. This can occur for several reasons. First of all, there are structural reasons where a person buys a new house, pays off his old mortgage and takes out a new one. This could occur if someone gets a new job, or if there's a marriage or a death in the family. The focus in mortgage-backed securities is more on the economic reasons for prepayments. Let's say that three years ago you took out a mortgage at 14%. Currently, you could probably walk into your local savings and loan and take one out for 10.5%. The 350 basis point savings is probably enough incentive for you to go through all the hassles involved in paying off the old mortgage and taking out a new one. On the other hand if you took out a mortgage a year ago, on which you're paying 11%, you would only save 50 basis points by paying it off. This may or may not be enough of an incentive for you to actually do it. Finally, had you taken out your mortgage 10 years ago at 8%, there's no logical economic reason for you to pay it off early. This is very important to realize. As the market goes up, (i.e., interest rates go down) we expect prepayments to increase. If the market goes down (i.e., interest rates go up), we expect prepayments to decrease.

Prepayments are the main risk in mortgage-backed securities. We saw before that there is almost no credit risk involved in a CMO, so prepayments are the main reason that mortgages trade at a wide spread relative to Treasuries.

I've been speaking about the individual mortgage holder even though the mortgage you take out is packaged into large pools by a government or private agency. This means when we're speaking about prepayments, we're not talking about the prepayments of an individual as much as we're talking about average prepayments within a pool.

Prepayments can be measured in several ways. The easiest way is to assume a constant percentage each year. A more common measurement, however, is PSA. PSA stands for Public Securities Administration, and it's just a curve agreed upon in order to make the trading of mortgage securities more uniform. It also attempts to capture the fact that prepayments vary depending on when the mortgage was taken out. For example, if you took out a mortgage two months ago and the market goes way up, chances are you won't pay it off because of the points you just paid. If you've had your mortgage for 3 or 4 years, the points and the hassles tend to look less important relative to the money you can save. The PSA curve attempts to capture this by having an increasing amount of prepayments for the first 2.5 years and then levelling off at 6%.

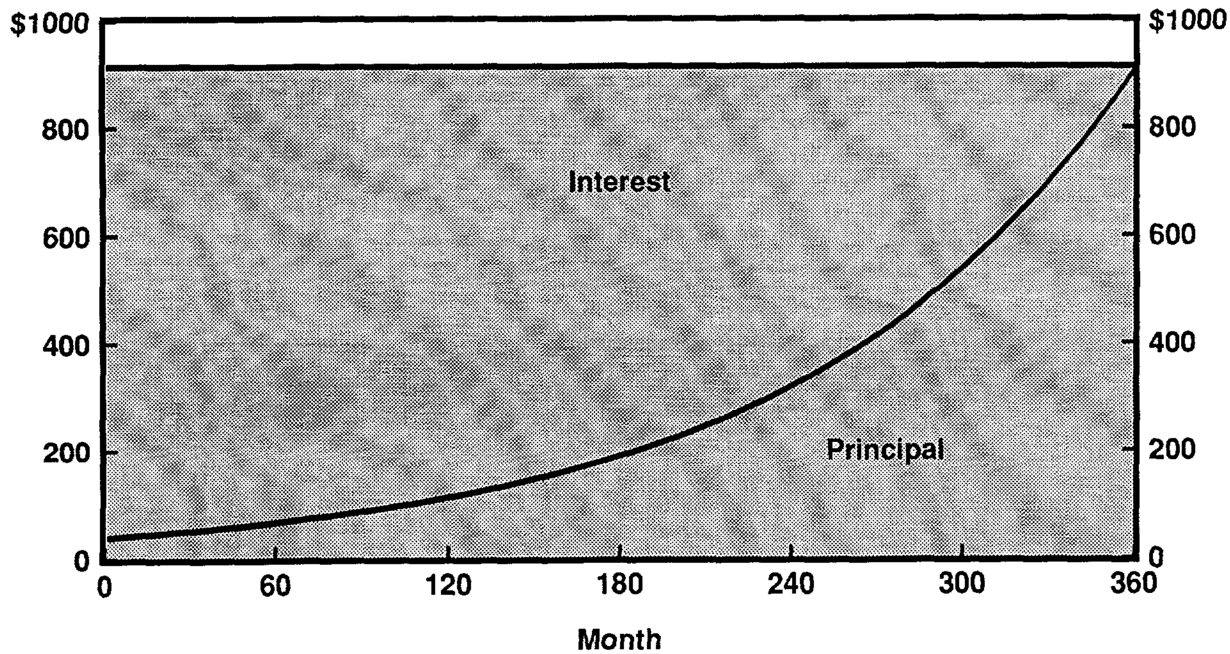
Prepayments are expressed as percentages of the PSA curve. A high coupon mortgage, like a 14% Government National Mortgage Association (GNMA), might prepay at 350% PSA. A current coupon like a 10% might prepay at 100% or 150% PSA, and a discount mortgage like an 8% might prepay at 80% PSA. This graph shows the affect of prepayments on the amount of principal distributed (Graph 2). Even at a low prepayment speed, such as 105% PSA, more principal is pushed to the front than in the standard 0% PSA assumption graph I showed earlier. As we increase to 140% PSA, the second diagram, more principal is pushed to the front. If we speed up even more to 177%, even more principal gets prepaid at the beginning.

The next graph represents the most basic CMO (Graph 3). The outline of the diagram shows the mortgage cash flows. All we do is cut up these cash flows into different bonds, which are called tranches. These tranches are usually designed to have specific average lives. What are average lives? It's just a measurement of the average length of time it takes for the principal to be returned in full.

If we take a look at this structure, all bonds receive interest from day one, except for the last bond, which is a Z bond and whose principal will accrete or grow. The A bond will receive both principal and interest from day one. It will receive all the principal plus its coupon payments from the mortgages until the bond is fully paid down. The B bond will receive coupon payments from day one but will not receive any principal until the A bond is retired. The C bond will receive interest from day one again but won't receive any principal until both the A and B bonds

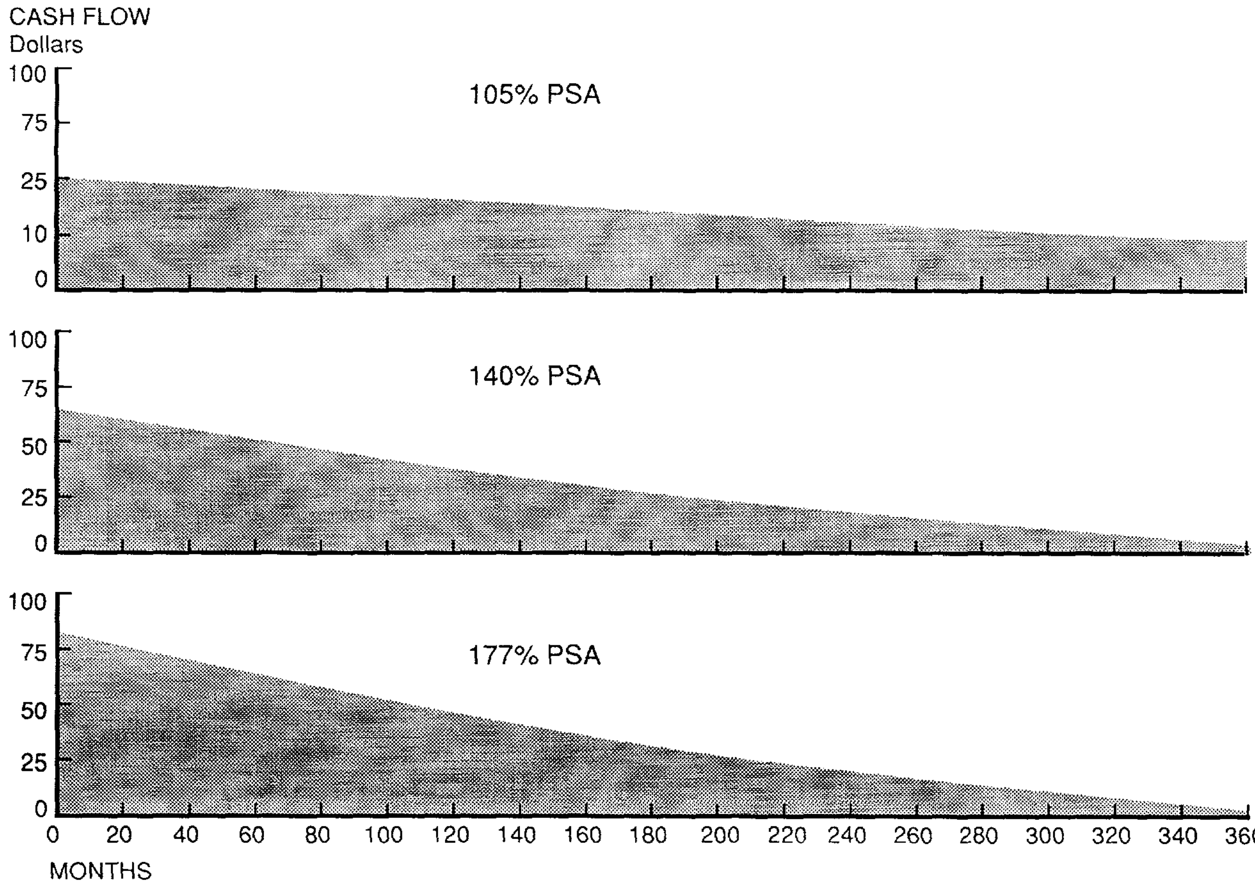
GRAPH I

Level-Payment Fixed-Rate Mortgage - Monthly Payment
10 1/2% Rate, 30-Year Term, $100,000 Original Balance



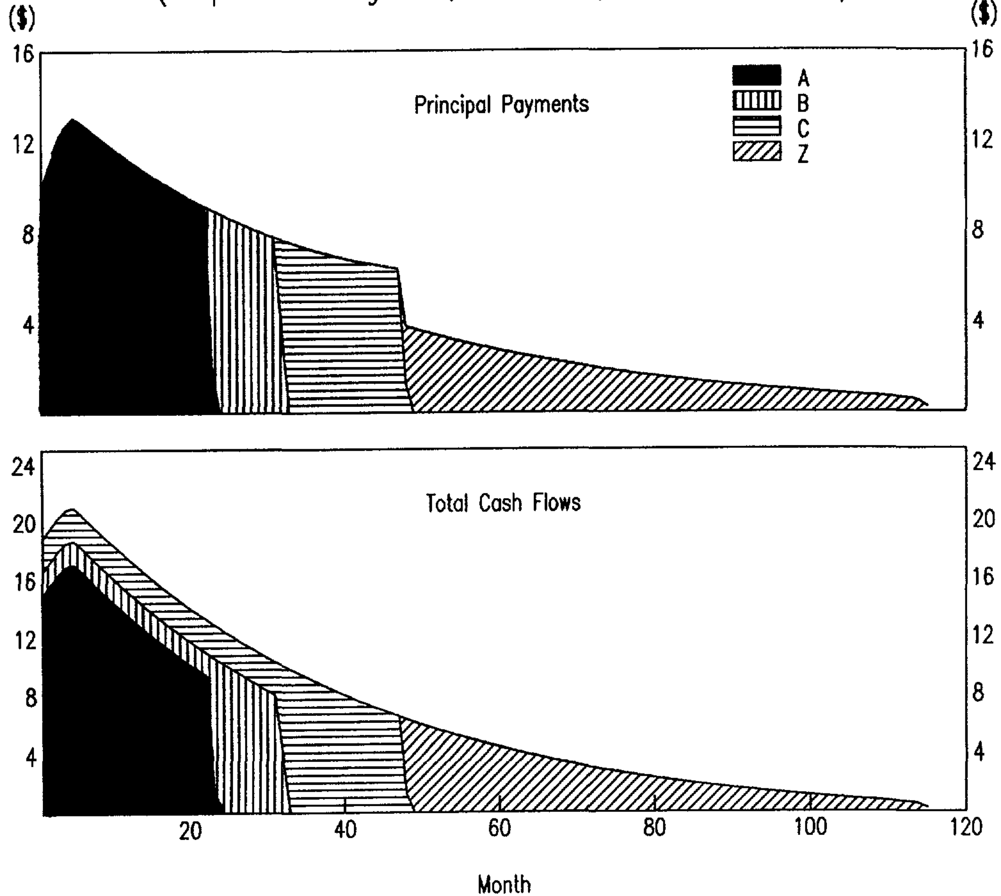
GRAPH 2

PRINCIPAL PAYMENT SCHEDULE



GRAPH 3

CMO Trust 28 -- Projected Cash Flows
(8 Apr 87 Pricing Date, 167% PSA, Dollars in Millions)



are retired. The back bond or Z bond is a little bit different than the others in that instead of receiving a coupon currently, it will grow or accrete at the coupon rate. By the time it begins to pay down, that is after the A, B and C bonds have paid down, the Z bond will be much larger than it was to begin with.

You might wonder why we go through all the trouble of cutting up these mortgages. The answer is that a lot of people are attracted to the mortgage market, because of the high yields they get over Treasuries, but not everyone wants to own an investment which matures in 30 years and has a 10- or 11-year weighted average life. By tranching up mortgages, it allows us to tailor the bonds to meet the different needs of the investor.

I will now give you some idea of who buys the different types of bonds. Short bonds in the 2- to 3-year weighted average life area tend to be bought by commercial banks. The mid-level, 5- to 7-year bonds are often bought by money managers. The longer maturities such as the C and Z bonds are often bought by insurance companies. Floaters are often bought by the Japanese and commercial banks. TACs and PACs are often bought by traditional corporate bond buyers because of their increased stability over regular bonds.

A mortgage yield curve exists which is very similar in nature to the Treasury yield curve. For example, 2-year spreads are generally less than 20-year spreads. That is, you get paid for moving out farther on the yield curve. Your spread is wider the longer the maturity of the tranche you buy.

In order to attract more investors into the CMO market, several new structures have been developed over the past few years. These include floating rate bonds, inverse floating rate bonds or Q bonds, PACs, TACs, "interest only," "principal only" and "super principal only" pieces and securitized residuals.

The idea behind a floater is relatively simple. Instead of having a fixed-rate coupon, the coupon floats at some index plus a reset. The index can be a Treasury rate, a cost of fund index, but most often it's LIBOR, or the London Interbank Offered Rate, which is much like the federal funds rate here in the United States. Floaters off mortgage-backed securities must have a cap or a schedule of caps. The cap is necessary because of the structure of the deal. A fixed rate bond such as a GNMA 10 or Federal Home Lone Mortgage Corporation 10 can be broken up into two floating rate bonds, one whose coupon rises as interest rates rise, that is a floater, and one whose coupon drops as interest rates rise, an inverse floater or Q bond. If they average out to the fixed coupon rate, the deal will support itself. For example, let's say we divide a GNMA 10 into two tranches of equal sizes, both with a 10% coupon. If interest rates (the index) go up 100 basis points, the coupon on the floater will go up to 11%. The coupon on the inverse floater will go down to 9%, and on average you've still got 10%. If interest rates go way up and the coupon on the Q bond goes way down, it can only go down to zero because you can't really ask investors to give money back. This necessarily implies that the cap on the floater will be no higher than 20%. In actuality, 20% is an awfully high cap for a floater. I just used it for illustrative purposes.

As I just said, Q bonds (or inverse floaters) move in the opposite direction of interest rates. The coupon will often go down at a multiple of the change in the index. A typical Q bond formula might be 14% minus 2 times the change in the index. If LIBOR was at 6% when the deal was initially priced and subsequently goes up by 100 basis points, we'd expect the Q bond coupon to drop 200 basis points. As I've said before, a Q bond will have a floor. It's often zero but sometimes is quite a bit greater.

The Q bond is a bullish investment, doing better as the market goes up. This is easily seen. If the market is up, meaning the index off of which the Q bond is set is decreasing, the Q bond coupon will go up. If the market goes down, the coupon on the Q bond will go down.

PACs are another new development. They're attractive because they have more stable cash flows relative to regular CMO tranches. They appeal to corporate buyers because of their stability. Stability exists because the PAC bonds have a schedule of principal repayment, much like a sinking fund. The schedule on a PAC bond is determined by a prepayment band. If the actual prepayments come in at a rate between the prepayment band, the principal repayments as specified by the PAC schedule will be met. Thus, these bonds offer protection from market fluctuations as defined by the prepayment range.

The way the schedule of cash flows is constructed is quite simple. We just amortize the collateral under the two prepayment arrangements. For example, assume the prepayment range is 75% PSA to 300% PSA. This graph shows the collateral amortized under each assumption (Graph 4). The minimum of the two curves is taken to be the PAC schedule. If prepayments come in between the curves, the schedule will be met. If they come in slower than 75% PSA, the bonds will extend. If prepayments came in faster than 300% PSA, the bonds will shorten.

Mortgages have a certain amount of entropy. If we take one bond and make it more stable than the underlying mortgages, this implies that other bonds have to be less stable than them. These are known as PAC support pieces or companion bonds. In Graph 5, the companion bonds are the A and B bonds. If things slow down to 100% PSA, the A bond extends from about 100 periods to 120 periods. If prepayments pick up to 250% PSA, the A bond shortens quite a bit from about 100 periods to 25 periods. The B bond has the same sort of characteristics. These will extend or shorten more than the regular A, B, C, Z structure that we looked at in the beginning.

Because of their stability, PAC bonds are priced at tighter spreads than regular A, B, C, Z bonds. PAC support pieces are priced wider than regular bonds because of their variability in average life and yield.

This diagram shows how we can cut up a PAC schedule just as we cut up a mortgage into different maturity or average life tranches (Graph 6). Y1 represents a 2 to 3-year average life PAC, Y2 is a 7-year PAC, and Y3 is about a 10- or 15-year average life PAC bond.

Something else new is the targeted amortization class or TAC bond. TAC bonds are very similar to PAC bonds in that they have a schedule of principal repayments. However, TAC bonds are not constructed as the minimum of two curves but are constructed as one curve, usually the pricing speed. TAC bonds will extend like regular bonds under slow prepayments but will not shorten as much as regular bonds under fast prepayments. That is, they have a certain amount of call protection against fast prepayments.

Because of their performance characteristics, TACs trade somewhere in between PAC bonds and regular bonds. This diagram again shows how we cut up a mortgage, this time into a TAC and a TAC support piece (Graph 7). The TAC support piece, much like the PAC support, will shorten or lengthen a lot more quickly than a regular bond. Under fast prepayments, the TAC bond will not shorten very much, but the TAC support bond will.

Another development is the idea of dividing up mortgages into their interest and principal only pieces. All one does is separate a mortgage into its interest component and its principal component and sell these off to different people. An IO bond, or interest only bond, is a very bearish investment. It does better as the market goes down. Since we're only earning interest, and not receiving any principal, we make out best the longer the balance on which we're earning interest is outstanding. This occurs when interest rates go up (meaning prepayments decrease). On the other hand, if prepayments increase, the balance will pay off more quickly, and we won't be so well off.

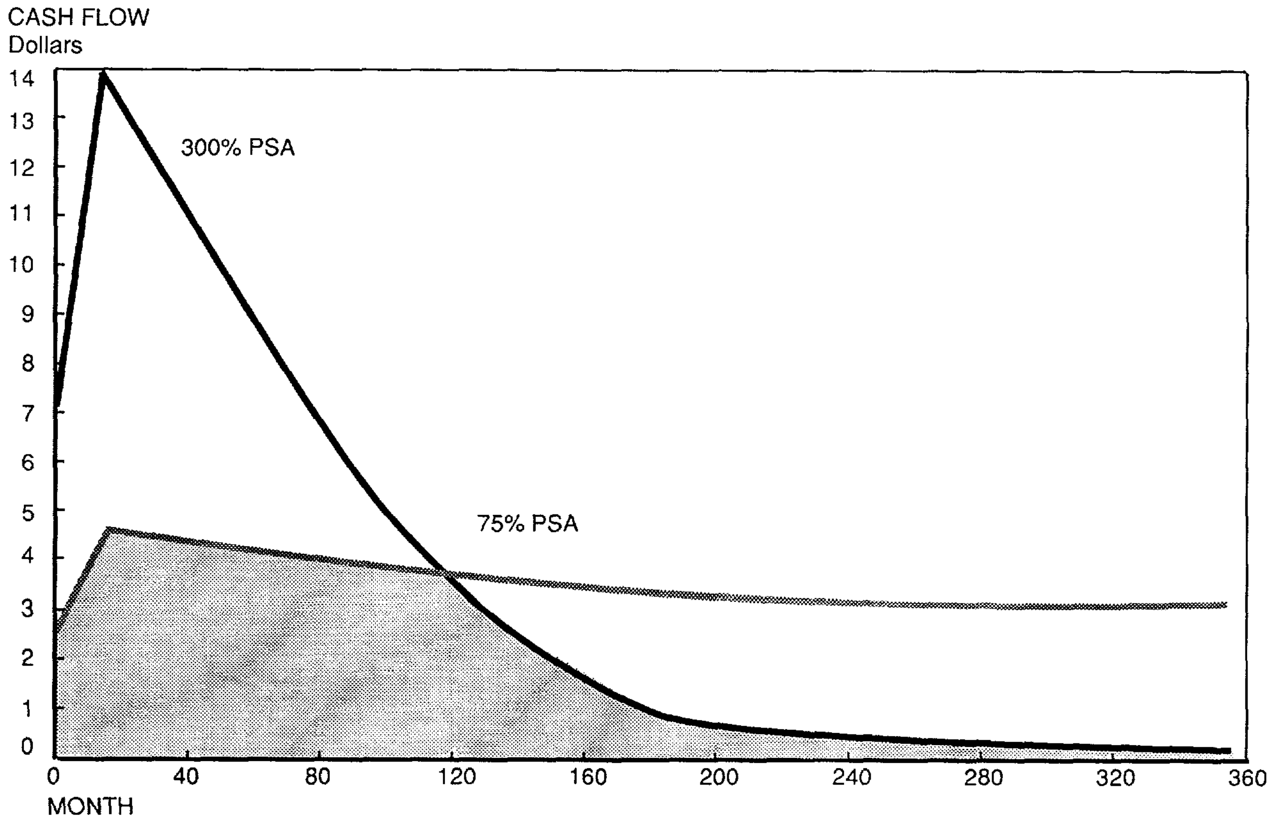
A principal only (PO) bond is basically the opposite of an interest only. POs are sold at a fairly deep discount, usually at $50 or $60 per $100 of par, and they're a very bullish investment. That is because as the market goes up, interest rates go down and prepayments increase. A bond we paid only $50 for is being returned to us at par sooner than expected. If we pay $50 for something one day and get back par the next day, we make out very well. If the bond extends, we're not very happy because we're not receiving any current interest, and we're getting back the principal later than expected.

A development after POs was Super POs. These bonds are very long and have an even deeper discount in general than POs. They're often either TAC or PAC support bonds. As we saw before, TAC or PAC supports can shorten (or lengthen) a lot more quickly than regular bonds. This is good for a super PO bond because it's very long to begin with. If we only paid $30 for the bond, and get back the $100 sooner than expected, we can pick up quite a bit of yield.

This diagram shows a deal which incorporates most of the bonds I've just talked about (Graph 8). The A, B, and C bonds are TACs, the D bond is a floater, and the E bond is a Super PO. The deal was priced at 115% PSA. The Super PO is very long to begin with. If prepayments really pick up,

GRAPH 4

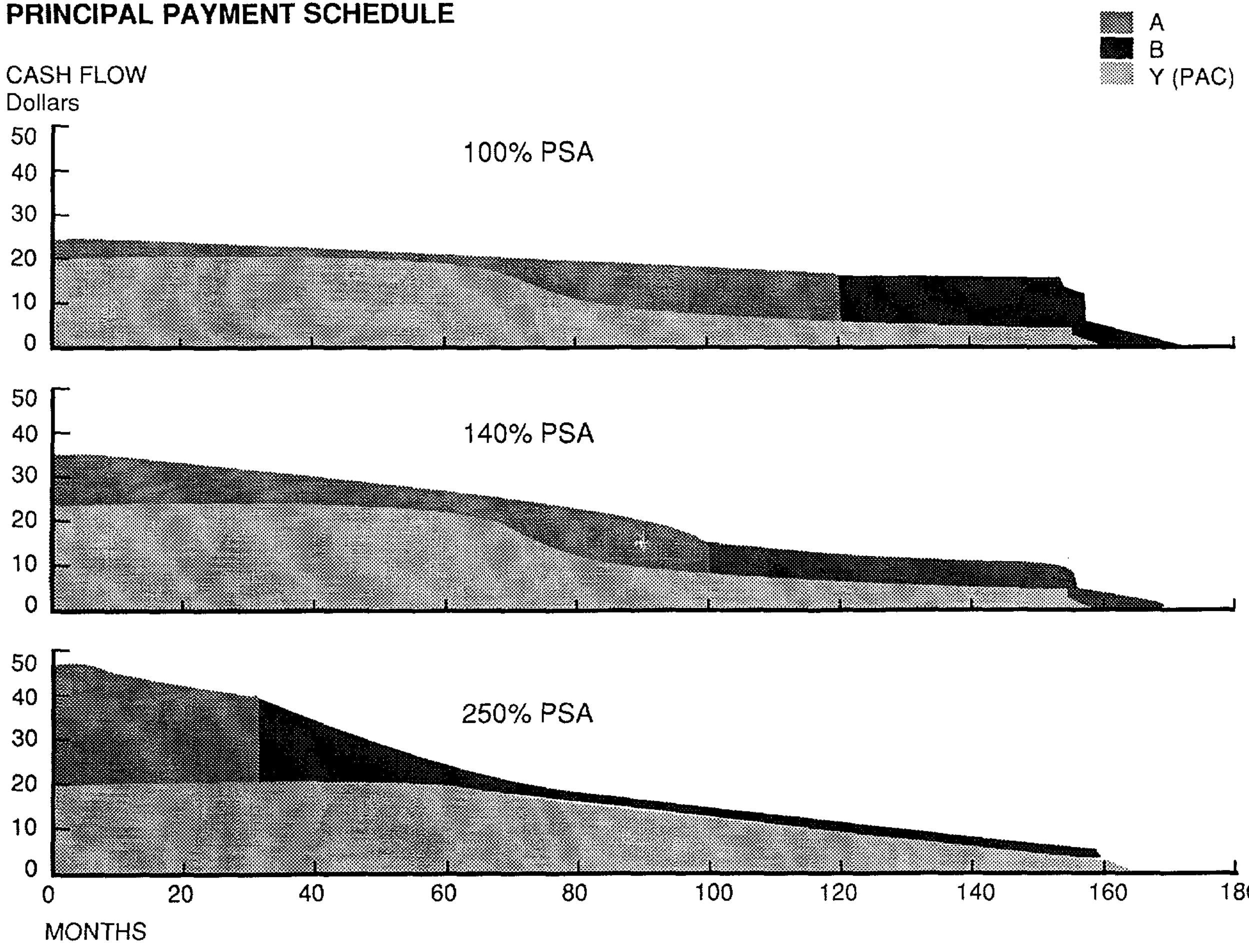
CREATING PAC REDEMPTION SCHEDULE WITH A "GUARANTEED" RANGE OF 75-300% PSA



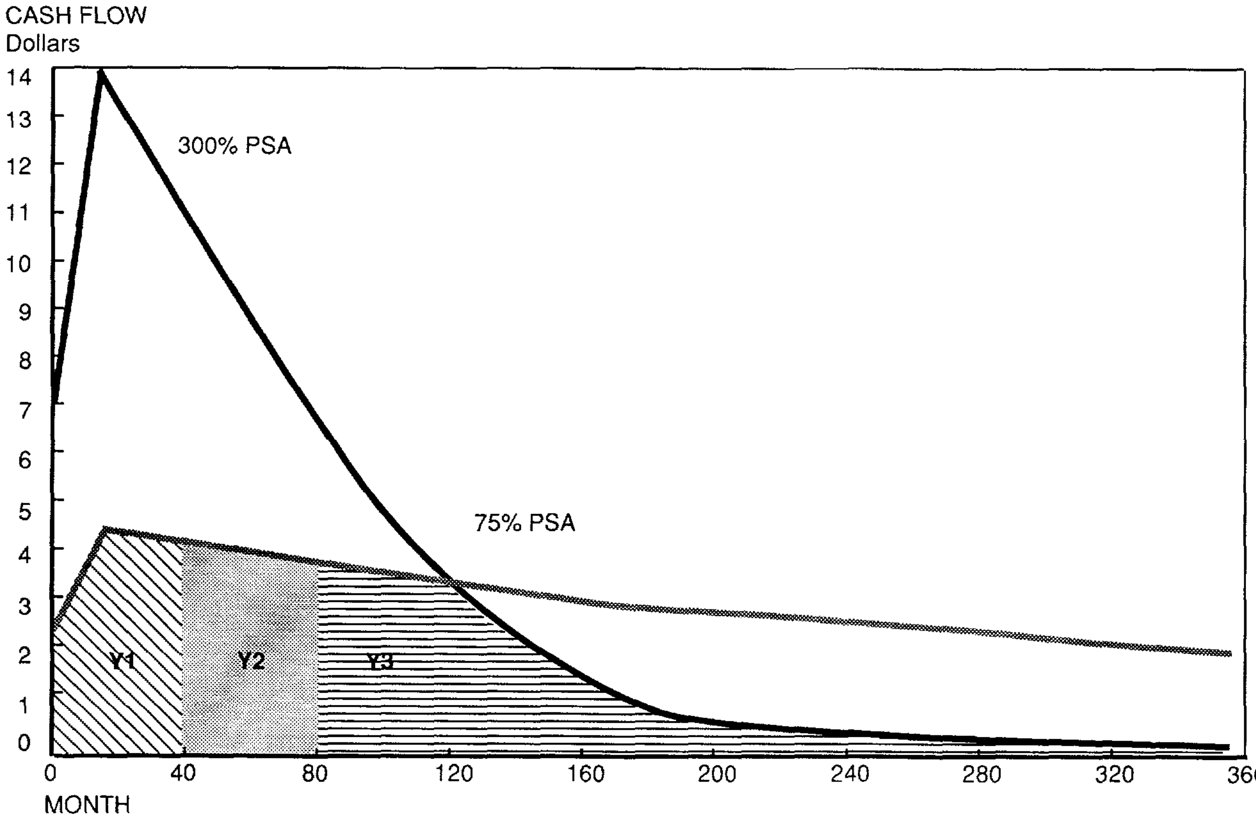
COLLATERALIZED MORTGAGE OBLIGATIONS

GRAPH 5

PRINCIPAL PAYMENT SCHEDULE

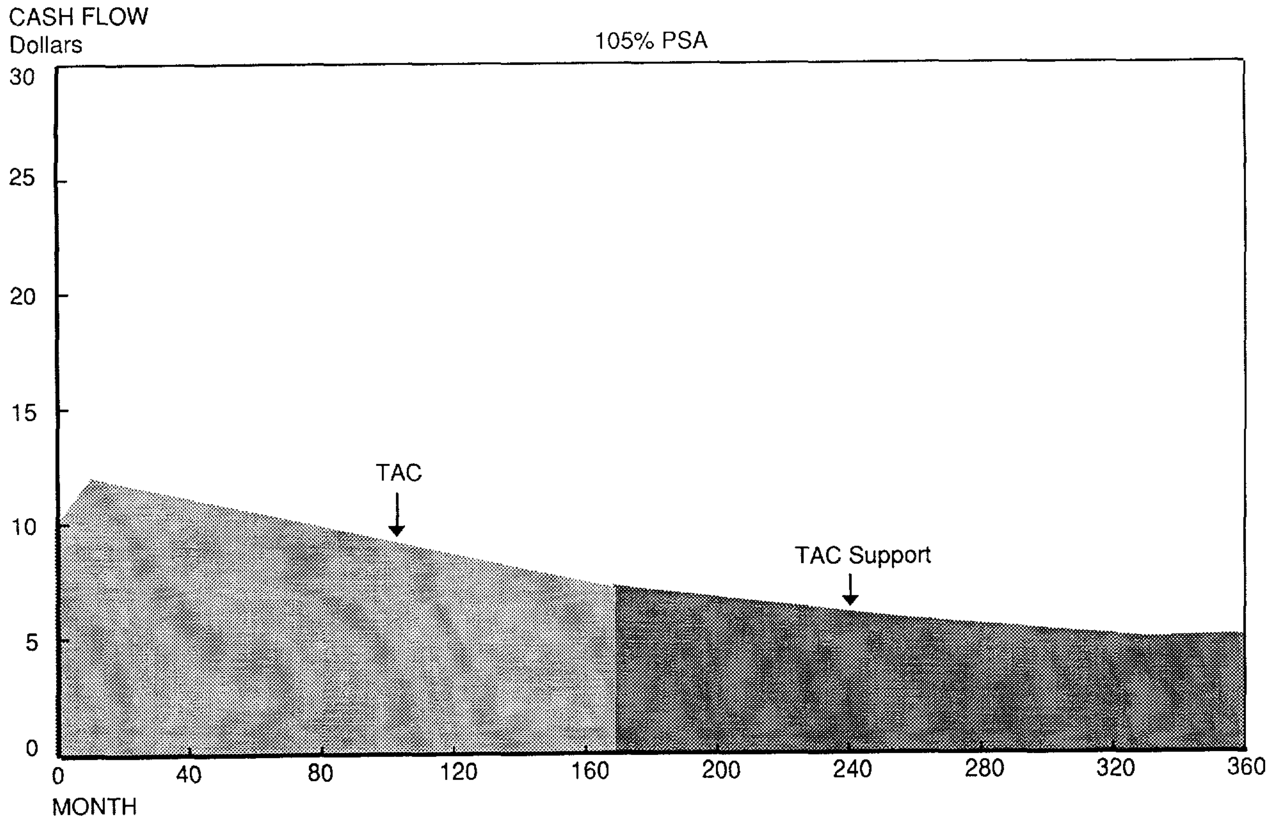


CREATING MULTIPLE PAC REDEMPTION SCHEDULE WITH A PROTECTED RANGE OF 75-300% PSA



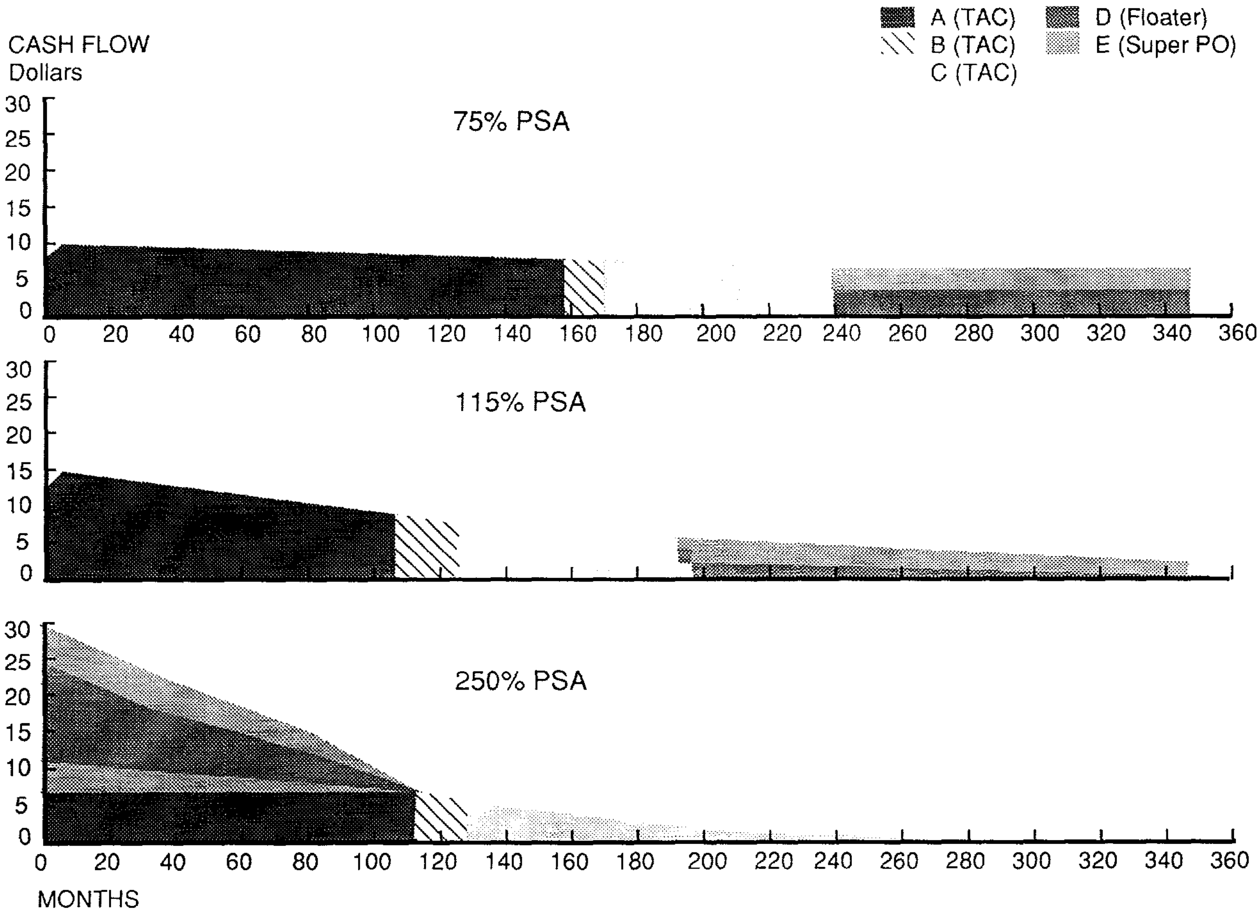
GRAPH 7

CREATING TAC REDEMPTION SCHEDULE



GRAPH 8

PRINCIPAL PAYMENT SCHEDULE



the average life of the Super PO really shortens. This is where you pick up yield. However, if prepayments slow down, the Super PO can't extend much more than it already is.

Previously, I had mentioned that having a floater in a deal necessarily implies having an inverse floater or a Q bond. You don't see that on this diagram because in this deal, the Q bond was put into the residual. I haven't mentioned residuals before, but every CMO deal must have a residual. The residual can be any one of the bonds in the deal. Historically we've taken the most volatile bond, given it the highest yield and sold it off as the residual. However recently, things have been changing. Residuals have become a lot more stable as even PAC bonds have been called residuals. Residuals are also being securitized, which means they're being sold in a bond format. The bond format helps to lower the bid offer spread and increases the liquidity on residuals.

We've just taken a look at how level pay mortgages work, how prepayments affect them, how these bonds are pooled into large groupings and then put into CMOs, how these are then cut up into a variety of different tranches with different performance characteristics, and how all these different bonds are sold off to many different investors.

MR. DAVID L. MOORE, JR.: My colleague, Joe Sindelar, and myself both work for Axe-Houghton, and we're here for two reasons. My presentation is going to give you an overview of how CMOs and mortgage-backed securities fit into an insurance company's overall investment strategy. Joe will then speak about the specifics of managing a mortgage-backed portfolio for one of our clients.

I will give you a brief introduction to my company, Axe-Houghton. We are a wholly owned subsidiary of USF&G. Currently we manage a total of $8 billion in insurance company assets, $6.1 billion of that is fixed income and close to 30% of that, or $1.7 billion, is in CMOs and other mortgage-backed securities.

I will now give you a breakdown of our overall approach to investment strategy for our insurance clients. Basically we try to manage a product investment model for a specific line of business that corresponds to its required interest rate spread. We've found in this process that mortgage-backed securities and CMOs work out very nicely for practically any kind of interest sensitive insurance product. We also work to maintain a duration match between the assets and liabilities of our clients. Most of them want to minimize the market value risk to surplus.

I just want to pause for a minute and focus on what is meant by duration. By duration I mean an option-adjusted duration, not a Macaulay duration, and let me tell you how it works. Suppose interest rates were to change by 1%. A typical mortgage-backed security, which had a duration of four years, would see its market value change by either plus or minus 4%. Again, when talking about interest sensitive products or longer lines of business like structured settlements, you can mix and match the particular characteristics of mortgage-backed securities to match up with these durations very nicely.

Cash-flow matching is also important in our overall investment strategy. Depending on the requirements of a specific company, one can specifically look at matching certain portions of their cash flows with various principal and interest payments. In the case of longer securities like POs, they can be used to match the longer-term balloon payments on certain liabilities.

In doing both duration and cash-flow matching, we find that it's necessary to do quite a bit of scenario testing. We run our assets and liabilities through a number of different interest rate paths to determine the relative risk factors and option-adjusted factors that might be encountered in different interest rate environments. Again, we've already seen that you need to do quite a bit of this testing anyway to properly evaluate a mortgage-backed security. There are quite a lot of sophisticated modeling techniques that can aid in achieving the kind of precise asset liability strategy goals that you might desire.

Diversification and quality are obviously critical these days. We've found that with our insurance company clients, we generally have a very high quality requirement, usually a minimum Single-A weighted average credit rating on the overall insurance portfolio. Mortgage-backed securities and particularly CMOs, virtually all of which are Triple-A rated, offer a very nice trade-off against some of the credit risks one might want to take in the private placement or high yield bond market.

Finally we want to maximize the return for our client, and we very firmly believe that you should not purchase a mortgage-backed security unless you first do some sort of total return analysis. While the yields are attractive, if you don't take into account the various option characteristics, we think you can be misled into perhaps buying a security that might not turn out to be what you initially thought it was.

One of our larger clients has experienced a very rapid build-up of assets over the last five years. The large growth in assets has coincided with an increased demand for annuity products, in particular after the market crash in October of 1987. This has forced us to develop some very strong analytical capabilities in the mortgage-backed security area and to use them in our overall asset allocation scheme. In particular, our models can take a portfolio and evaluate the various prepayment and call risks, and also monitor the "option-adjusted spread" over Treasuries that the portfolio is actually receiving.

Finally, I thought I'd give you an example of one of our product investment models for a single premium deferred annuity (SPDA). We basically have six categories: high yield bonds, mortgage-backed securities, investment grade bonds, debt options (which are covered call writings of Treasuries), commercial mortgages and dividend capture. The model tells us to invest more in mortgage-backed securities than in any other investment. I again think the key point to make is that they offer a nice offset to any exposure one might have in the high yield bond area. The yield, obviously not as attractive as the high yield bond, still offers a very attractive yield over Treasuries. At 4.5 years, its duration may be a little long for a one- or three-year credited rate type of SPDA. For a 5-year (or longer) SPDA, the duration match is very good.

MR. JOSEPH B. SINDELAR, JR.: There are three areas I'd like to address concerning CMOs: The reasons we buy the product, the type of portfolio we construct, and how we analyze the securities.

The primary reason we buy this product is the yield. As you can see in Graph 9, the X axis represents years to maturity and the Y axis shows the yield to maturity. The line along the bottom shows the Treasury yield curve as of September 29, 1989. The top line represents the incremental yield for purchasing CMOs. As you can see, the additional spread for buying CMOs ranges from 110 for a 2-year duration to 155 for a 20-year duration. This is for the cleaner type of paper, not the support tranches that were referenced earlier and not for the tighter, nominally richer PAC bonds. This means CMOs give you a tremendous amount of yield. In addition, the credit quality is AA or AAA. Their liquidity is comparable to the corporate bond market. Even though they're less liquid than straight pass-throughs, they meet the needs of most insurance companies that generally follow a buy and hold strategy. Instead of having principal come back over 30 years, as a pass-through typically would, the CMO can be structured to have cash flows come back over a relatively short period of time, such as 5 years or less. Another advantage of the CMO market is the structuring of particular deals to meet particular liabilities. Now you can better match the cash flows against the liability to meet the specific needs of a buyer.

Of course, CMOs do have one major drawback, namely average life variability. As we were shown earlier, the interest and the scheduled principal amortization are known quantities, but the prepayments are variable. We have to manage this variable by buying more stable collateral which is less exposed to the prepayment option.

Table 1 represents two typical 7-year CMOs.

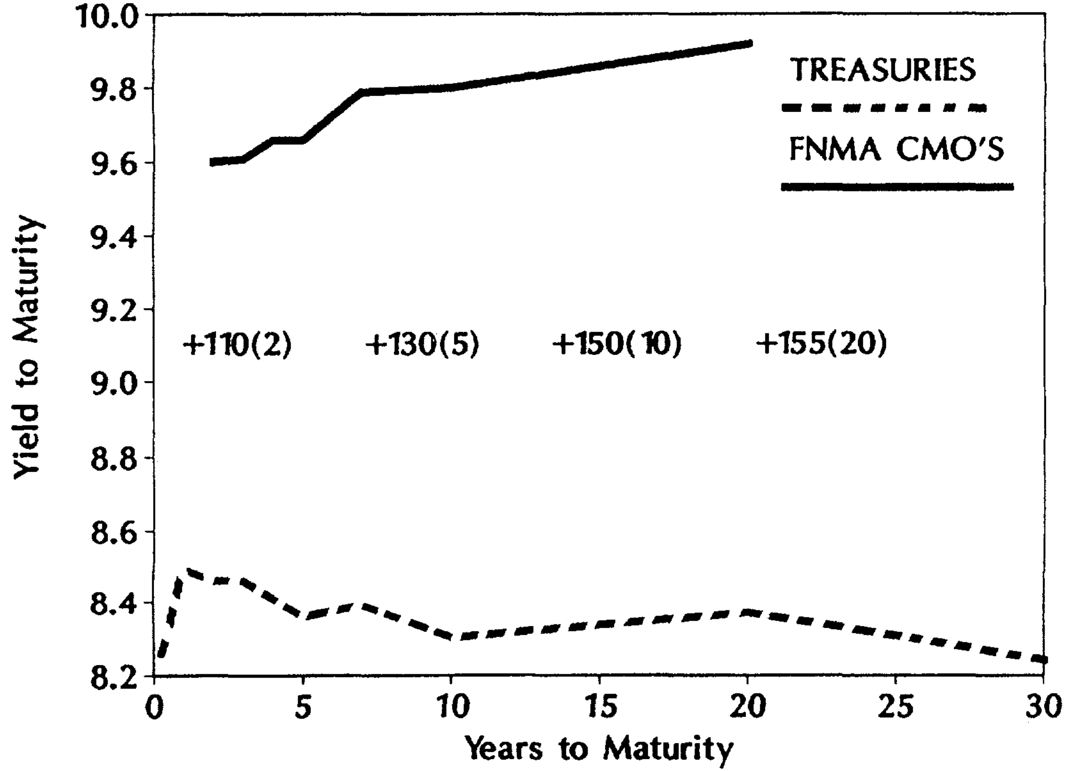
TABLE 1

AVERAGE LIFE VOLATILITY

Rates	FN 89-38C (+135)	FN 89-4G (+165)
+300 bp's	9.0 years	12.66 years
+200	8.8	12.03
+100	8.4	9.32
UNCH	7.6	7.27
-100	6.4	3.75
-200	4.6	2.66
-300	3.5	2.09

GRAPH 9

TREASURY AND CMO YIELD CURVES
SEPTEMBER 29, 1989



What I'm attempting to do in Table 1 is show the average life variability between the two different securities. The first column represents interest rate movements relative to a level scenario. The second and third columns are both 7-year CMOs. The second column is priced at 135 off the 7-year Treasury while the third column is priced at 165 off the same rate. You are given 30 additional basis points to buy the security on the right relative to the one in the middle. In our opinion, you're not given enough extra yield. To see this, let's concentrate on the average life variability of the two securities as rates move plus or minus 100 basis points from the starting point. The security on the far right goes from a 7.27 year average life to 9.32 (if rates rise), and to 3.75 (if rates fall). The corresponding numbers for the middle security are 8.4 and 6.4 (from 7.6). We believe the 30 basis points do not sufficiently compensate for the additional volatility of the far right security.

The above example illustrates the concept of option-adjusted spreads along with the effect of duration when analyzing a security. You cannot just look at a static modified or Macaulay duration. You must also consider what happens to the security as interest rates rise and fall, meaning the prepayment option comes into effect. While I'm on the down side of these securities, let me say they can be very challenging for a company's accounting staff. It's an item that needs to be addressed when the securities are used in a company's portfolio.

I'd now like to discuss a typical life insurance portfolio we manage, and the type of securities we put into it. We use a limited amount of straight pass-throughs, and by straight pass-throughs I mean GNMAs, FNMAs and whole loans. While these securities tend to be more liquid, we feel the increased liquidity is not needed. There are also other reasons we prefer to buy the CMO instead.

Commercial loan-backed deals tend to have more stable cash flows than the single family home product, and it also adds diversification to the portfolio, but again, a limited amount of this product is used in the portfolio. The primary source of investment in this portfolio is the CMO, agency issued, agency backed and the whole loan product.

The agency issued CMO has been the primary issuance in the last two years. It carries the same guarantee as straight debentures of the agency. It appears to be preferable to buy a PAC bond at 70 basis points off the five-year rate instead of a debenture trading at 20 or 30 basis points off. As was shown earlier PACs give you interest rate protection, say plus or minus 200-250 basis points, in that security's average life movement.

Agency backed CMOs do not carry quite the same liquidity as an agency issued CMO, but they do carry the Triple-A rating and are very solid securities to own.

Another type of product we prefer to buy and allocate about 20% of the portfolios to is the whole loan CMO. They're structured to meet Standard & Poor's depression test scenarios which normally gives them a Double-A and most often a Triple-A rating. They're a little less known and harder to model (so they're less liquid). For that we're given an additional 30-40 basis points in yield, and the market is now approaching a point where almost 60 basis points can be given to buy it. That's an attractive place to put some assets, a relatively small amount such as 20%. It can provide a substantial incremental yield, while the lack of liquidity can be handled by most insurance companies.

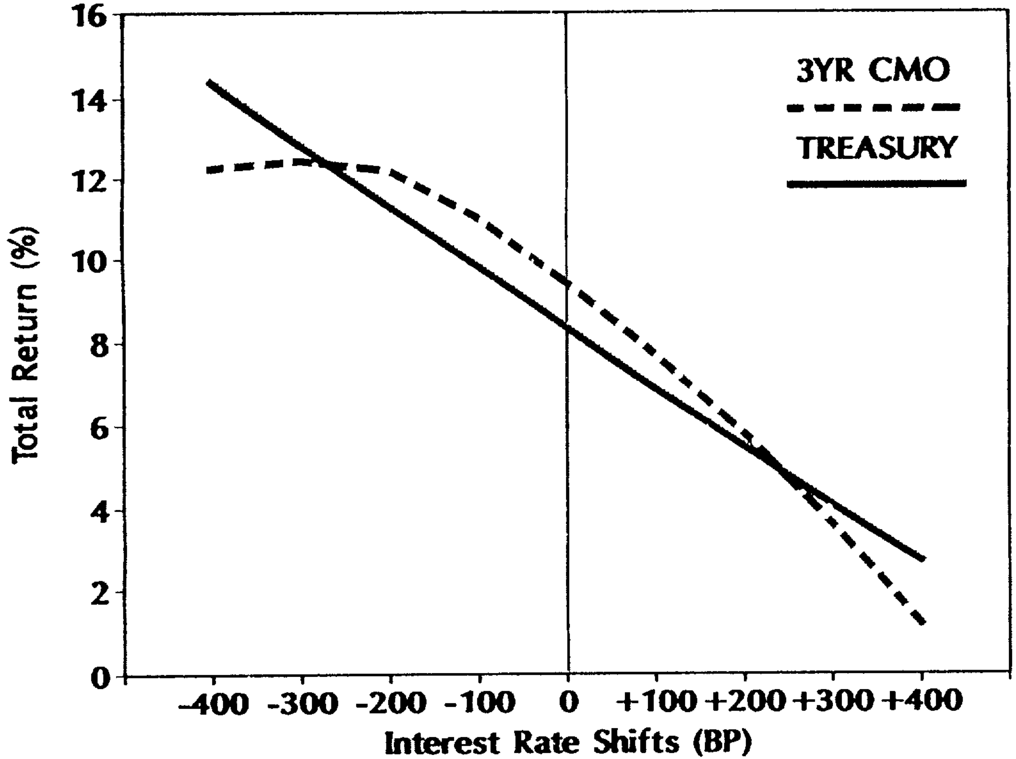
Finally, approximately 10% of the assets are allocated to other types of derivatives. These consist of a residual product, a higher yielding type of residual product that ranges from 12-18% in yield, plus a combination of IOs and POs used in the portfolio to manage some of the prepayment volatility.

I'd now like to talk about how we analyze the CMO product. As Dave mentioned earlier, you really can't look at this product just on a yield basis. As interest rates move, the characteristics of these securities change considerably. We analyze the product on a total return basis, and by total return I mean the coupon income plus the change in the market value of the security.

This graph shows the total return projected over a one-year holding period for a three-year CMO and a similar duration Treasury security (Graph 10). The total return is on the Y axis, and the X axis represents interest rate movements. You can see that the CMO provides an incremental return above Treasuries as rates move plus or minus 200 basis points. That's the general approach we

GRAPH 10

THREE-YEAR CMO VS. TREASURY PROJECTED ONE-YEAR TOTAL RETURN



take towards managing this product. We try to provide an incremental return above Treasuries for a plus or minus 200 basis point range and try to maintain that yield as interest rates move.

I'd like you to remember this picture as I take it one step further to the portfolio context. This is a sample of one of the portfolios we manage, again using projected total returns for a one-year holding period (Graph 11). The first column shows the five different types of CMOs in the deal. You have a strip coupon (which is just the part of the coupon in a deal that is backing the CMO structure), the basic normal CMO, the TAC bond, an accrual Z bond and a PAC bond. The second column is the coupon rate on the various securities and the third column gives the average life. You see a combination of various average lives have been used to structure an average life on the portfolio of approximately eight years. The columns on the right are the expected total returns as interest rates rise and fall.

What we're able to do here is combine the various characteristics of different securities. The PAC bond is lower yielding with more stable cash flows while the accrual bond is a more bullish type of security. The very first security (strip coupon) is also a very bullish security. What we do is combine the various types of securities to provide the largest incremental return over Treasuries we can while maintaining as much as possible that additional spread as interest rates rise and fall.

Let me go back to Graph 10 for a moment. You can see that we've theoretically provided an incremental return over Treasuries plus or minus 200 basis points. Near the extreme positions (i.e., plus or minus 200 basis points), we start getting into areas where we might underperform Treasuries. In order to manage this, we might add IOs and POs to the portfolio.

I'd just like to close with three miscellaneous items. They are goals of ours and also goals I think the industry needs to address. One is segmentation. We currently manage the entire mortgage portfolio against the duration of the entire liability side. Eventually we'd like to reach a point where we manage the liabilities with specific securities on the asset side. A good example would be using long discount Z bonds to back the longer duration liabilities like structured settlements. This is clearly preferable to looking at everything in the whole portfolio context.

A second item is consistency with modeling. As you can imagine, the modeling is very sensitive to the assumptions used. This means it is very important to be certain that your asset models and your liability models both use similar or consistent assumptions.

The third and final item to address is the concept of book yield updating. When the CMO is purchased, it's purchased at a certain assumed prepayment rate based upon an interest rate projection. As interest rates change, the prepayment rate changes and so does the yield on securities that are purchased away from par. Currently, I think it is the norm in the industry not to have a way to update the yield that is carried on the books. It is important we evolve to a point in time where we at least do monthly, if not more often, updating of the current book yield as interest rates rise and fall.

MR. MARK R. HANCOCK: Unfortunately in going last, you can't help but have some overlap, but what I hope to add to this discussion is my point of view, a mortgage research point of view, and that's trying to identify the relative value between securities or trying to identify securities that fit particular needs or particular portfolios.

Perhaps the greatest mistake any mortgage investor can make is to assume that the market for CMOs is simply a generic one, meaning that CMO classes with similar characteristics, such as coupons and average lives, will perform in roughly the same manner and therefore subject the investor to the same types of risks. Nothing could be further from the truth. Performance is determined as much, if not more, by the structure of the overall CMO rather than the individual class characteristics. A CMO issue of today is primarily a matter of proportioning out the risk associated with the prepayment or underlying call option of the collateral. The task that investors face is to assess the risk inside each individual class and to determine whether it fits their specific portfolio and whether they're offered adequate compensation for assuming those risks. In making this assessment, it's important to remember that CMOs are a zero sum game. In other words, the risk taken out of one class must necessarily be redistributed to the other classes. Using the example we saw earlier, the cash-flow stability of a PAC comes at the expense of the resulting cash-flow instability of the non-PAC classes.

GRAPH 11

PROJECTED TOTAL RETURNS
Holding Period: 9/26/89 - 9/26/90

Deal & Tranch	Coupon	Average Life	Expected Total Return -200	-100	0	+100	+200
STRIP COUPON							
MDCAI11 2	7.000	4.80	16.78	14.44	9.38	4.15	(2.05)
NORMAL							
GOLD3B 4	6.000	4.71	17.99	14.44	9.32	3.16	(5.82)
CWIDEE 4	8.850	6.54	15.25	13.09	9.77	5.07	0.13
TAC BOND							
FHRB1 2	9.850	7.28	10.30	11.77	9.46	6.42	2.60
ACCRUAL BOND							
SANT87B 4	9.500	13.99	24.30	19.41	10.43	(3.11)	(18.27)
PAC BOND							
FHR41 5	10.000	6.98	15.01	13.71	9.44	5.80	1.88
TOTALS AND AVERAGES:	8.675	8.15	17.25	14.74	9.77	3.08	(4.58)

PANEL DISCUSSION

In the first half of this talk, I am going to use some return of principal patterns to illustrate how PACs and non-PACs interact with each other. In the second half, I'm going to use some specific examples to show how an understanding of this interaction is important when it comes to selecting the right CMO class for a specific purpose or, conversely, in avoiding a disastrous result.

The next few graphs illustrate the cash-flow stability of PACs and how this stability comes at the expense of the associated non-PACs. This graph shows more or less a typical PAC in relation to the return of principal from the collateral (Graph 12). The collateral prepayment speed is 175% PSA.

This particular PAC has a 50-375% PSA protected range. That is as long as the collateral prepays at a single rate within this range, the PAC will receive a known set of cash flows. The area under the solid outer line constitutes the amount of collateral that can be dedicated to the non-PAC or support classes. As long as they are able, these classes absorb any fluctuations in the underlying collateral prepayments.

The next graph shows the same PAC under a 25% PSA scenario (Graph 13). Here the collateral is not returning enough principal in the earlier periods to fully meet the PAC schedule, and under these conditions, the non-PACs receive no principal return at all and the PAC is experiencing some shortfalls. After a while, scheduled amortization increases, and this causes the collateral to return more than enough principal to meet the PAC schedule. The cumulative shortfalls from earlier periods begin to be paid off, and only after the PAC gets back on schedule do the non-PACs start to receive principal. Since PACs have priority on principal from the collateral, their schedules and average lives are little impacted by scenarios such as this.

Going the other way, this graph shows a high prepayment scenario of 500% PSA (Graph 14). The large principal payments in excess of the PAC schedule go entirely to the non-PACs, and only after the non-PACs have been retired does the PAC start to deviate from its PAC schedule. What happens is all the non-PACs have simply paid down, and the PAC becomes a standard class as it no longer has any non-PACs left to protect it.

Let us now consider an individual PAC bond with a protected range of 50-375% PSA. Since the actual prepayment rates experienced by the collateral determines the amount of non-PACs outstanding and, therefore, the amount of protection a PAC has, the protected range will continue to evolve over time. In other words, the range 10 years from now will not equal what it is today because there will be a larger or smaller number of non-PACs outstanding. To illustrate this, the same PAC with a 50-375% protected range was allowed to experience 100%, 200%, and 300% PSA prepayments for 2, 4, and 6 years. At the end of each horizon, the protected range was determined for each speed. As Table 2 shows, the lower the PSA speed, the higher the upper limit will increase, and the higher the PSA speed, the more the lower limit will rise. The reasons for this are fairly straightforward. Low prepayments cause relatively more non-PACs to remain outstanding. They just protect the PACs should prepayments subsequently increase, even if they increase more than the original protected range would indicate.

TABLE 2

EVOLUTION OF PROTECTED RANGE FOR A PAC BOND WITH AN INITIAL PROTECTED RANGE OF 50-375% PSA

	After 2 Years	After 4 Years	After 6 Years
100% PSA	50-435%	50-555%	55-740%
200% PSA	50-420	65-500	75-650
300% PSA	55-405	75-450	120-540

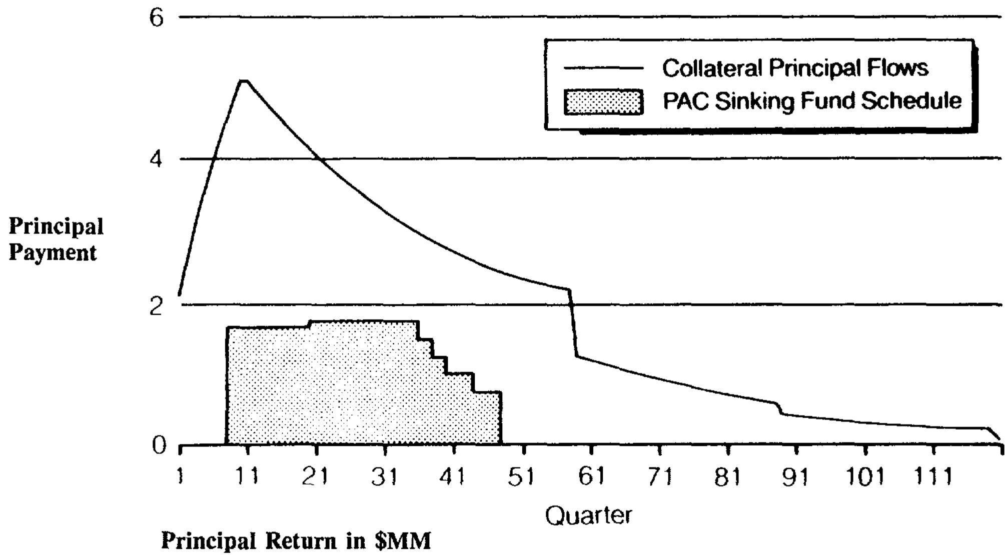
Source: Morgan Stanley & Company

I will now illustrate the impact that PACs exert upon their associated non-PAC classes. To show this I created two hypothetical CMO structures (Graph 15). They are identical in every way except that one structure contains a PAC while the other does not. CMO A is the CMO with a PAC, and the class with the vertical line shading is the PAC. In CMO B, the same class is just a standard class. CMO A also has a short average life class that is expected to return all of its principal before the PAC, and there's also a long average life class that is not expected to begin

GRAPH 12

PAC Schedule Location Relative to Expected Collateral Payments

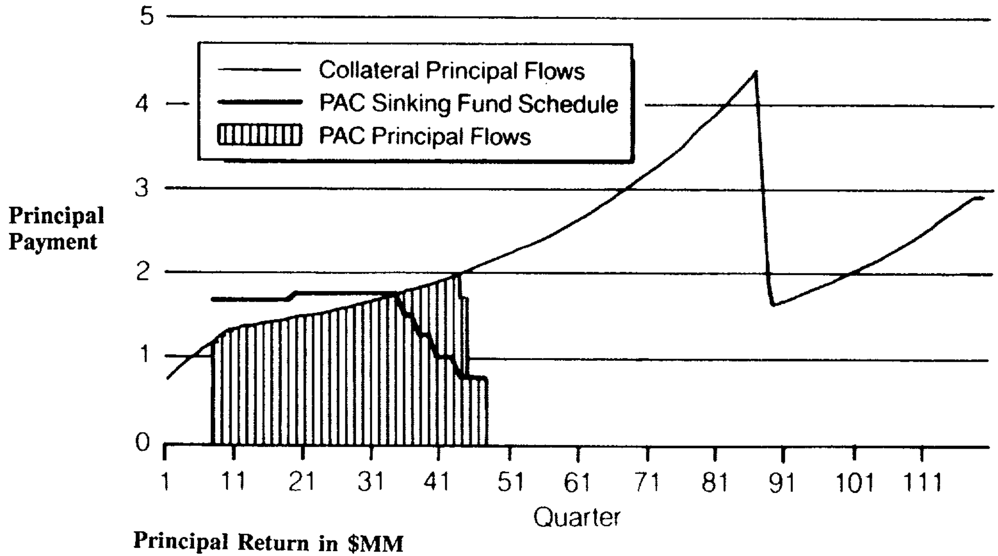
175% PSA Collateral Prepayment Speed
50% to 375% PSA PAC Protected Range



Source: Morgan Stanley

Collateral Principal Payments Causing Shortfall in PAC Schedule During the Early Periods

25% PSA Collateral Prepayment Speed

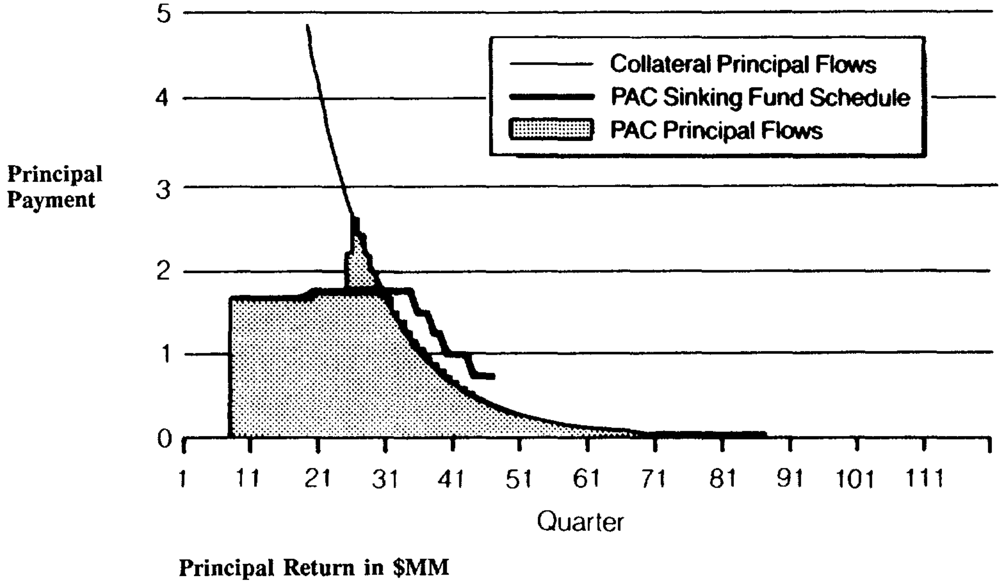


Source: Morgan Stanley

GRAPH 14

Collateral Principal Payments Causing PAC Schedule to be Exceeded During the Later Periods

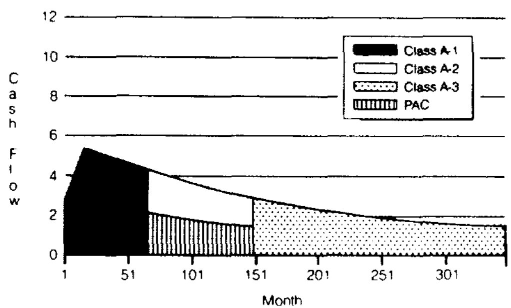
500% PSA Collateral Prepayment Speed



Source: Morgan Stanley

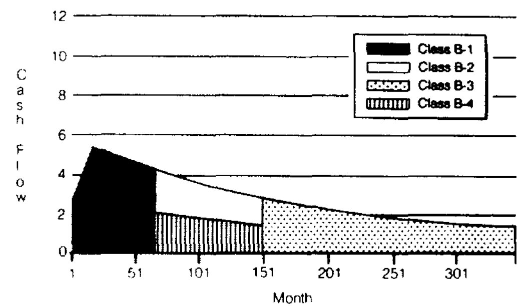
Initial Prepayment Speed

CMO A
PAC



Principal Payments per $1,000 Par Amount

CMO B
Standard



Principal Payments per $1,000 Par Amount

Source: Morgan Stanley

receiving principal until after the PAC has been fully retired. Finally, there's a class that's expected to pay simultaneously with the PAC. CMO B has identical classes to CMO A at the initial prepayment speed.

All we need to do to determine the effect of adding a PAC to the CMO structure is to vary the PSA speed and see what return of principal patterns result.

At a slower prepayment speed, we can make several interesting observations. First, as you would expect, the PAC continues to receive its scheduled payments while the non-PAC return of principal pattern simply slides over the PAC further out in time (Graph 16). In addition, the PAC causes the short class of CMO A to extend more than that from CMO B, and the intermediate class from CMO A also receives more of this principal later in time. Interestingly, the long average life class, whose payments don't begin until the PAC is retired, is differentially unaffected by the PAC. Since the slower prepayment does not cause it to pay simultaneously with the PAC, it cannot be affected by it. What we conclude from this is that a non-PAC class can only be affected by a PAC if it simultaneously pays with it.

Under a faster prepayment speed, the results are somewhat a mirror image of the slower prepayment pace (Graph 17). The long average life class of CMO A shortens much more than that of CMO B as the principal return jumps over the PAC schedule. The intermediate non-PAC class also receives more of its principal earlier in time. Since the short class from CMO A is not caused to pay simultaneously with the PAC, it is unaffected relative to the short class from CMO B.

From these three graphs, we can deduce certain conclusions that hold universally for all CMOs with PACs. As I stated earlier, in order to be affected by a PAC, a non-PAC must pay or be caused to pay simultaneously with the PAC. Second, non-PACs returning their principal before the PAC are subject to a differential extension but not a differential shortening in maturity. On the other hand, non-PACs returning their principal after the PAC are subject to a differential shortening but not a differential lengthening. Therefore, it is important to remember that non-PACs are not simply riskier classes because there is a PAC in the structure. What happens is the risks that are taken out of the PAC are asymmetrically and unevenly distributed among the non-PAC classes.

Next I have several examples that I hope will further illustrate the performance and value implications of the non-PAC and PAC relationship. The first example takes two different PACs and shows how the protected ranges evolve and how all PACs do not offer similar amounts of cash flow stability. The graph plots the change in the average life of two similar PACs as a function of PSA speed (Graph 18). One PAC has a 50-375% PSA protected range and the other has a 75-300% range. As expected, the two PACs have stable average lives and cash flows as long as prepayments are within their respective ranges. It is interesting to note that in addition to offering a smaller amount of protection, the 75-300% PSA PAC shows significantly larger average life deviations when prepayments move outside its range. This is generally true of all PACs. The smaller the range, the more the PAC begins to act like a standard class. The larger the range, the more protection it offers.

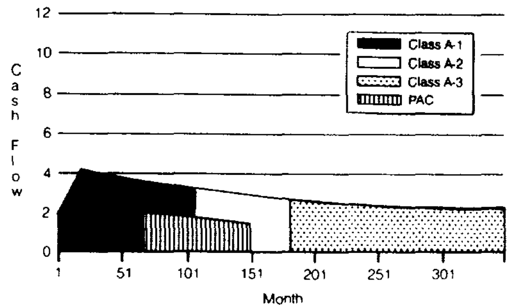
This graph plots the average life change for the same two PACs after four years of 300% PSA experience (Graph 19). The 50-375% PSA PAC demonstrates an expanded protected range, while the lesser protected PAC has a range that has actually shrunk to 250-300% PSA. The primary reason for this is that the lesser protected PAC comes from a structure that has only a small percentage of non-PACs, and consequently, they pay down rapidly in high PSA scenarios.

The moral of the story is that even PACs are not generic securities. You need to analyze them individually to see if they meet your specific investment goals and whether they offer a fair risk return profile for the actual risk you're assuming.

The next graph contrasts the performance of a 9-year average life PAC against a 15-year companion class as non-PACs are sometimes called (Graph 20). Here I've plotted the average lives of the 9-year PAC and the 15-year companion class with the changes in the 10-year Treasury rate. Both classes are from the same CMO structure, so they have the same underlying collateral, and the PSA speeds that we would expect to see are referenced along the horizontal axis. As expected, the PAC exhibits cash-flow stability over a wide range of interest rate movements. On the other hand, the non-PAC is a much riskier class. This long average life class is initially expected to

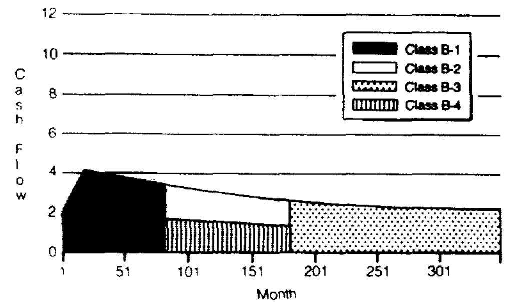
Slower Prepayment Speed

CMO A
PAC



Principal Payments per $1,000 Par Amount

CMO B
Standard



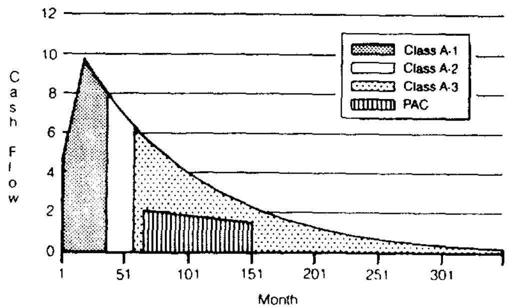
Principal Payments per $1,000 Par Amount

Source: Morgan Stanley

GRAPH 17

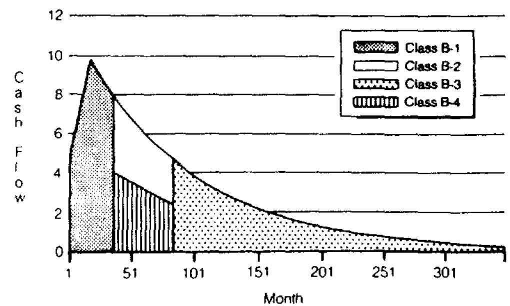
Faster Prepayment Speed

CMO A
PAC



Principal Payments per $1,000 Par Amount

CMO B
Standard



Principal Payments per $1,000 Par Amount

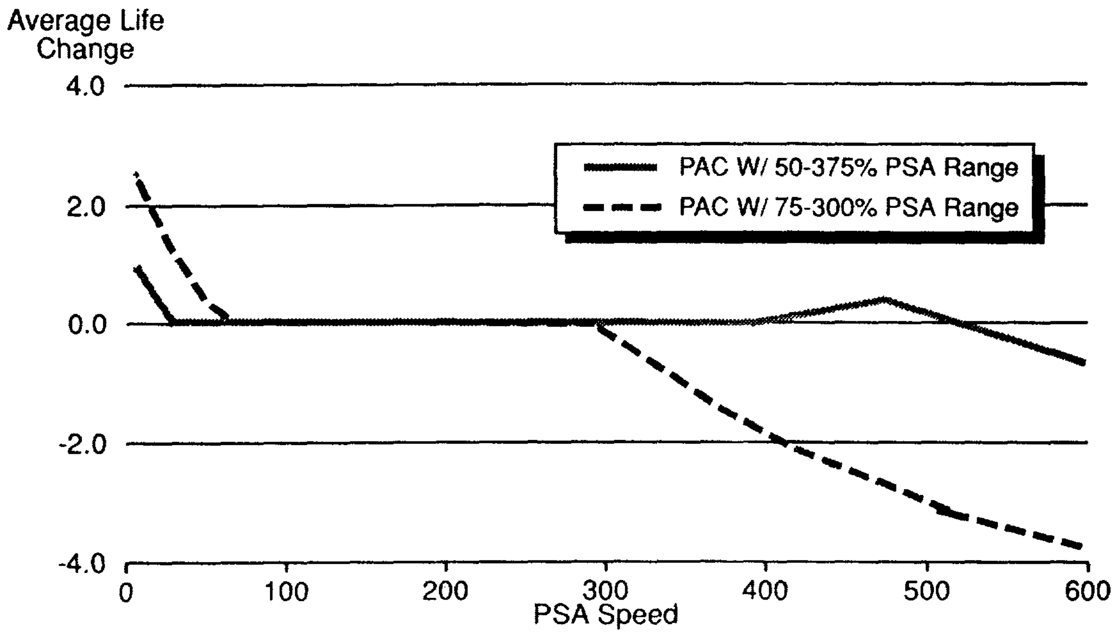
Source: Morgan Stanley

PANEL DISCUSSION

GRAPH 18

PAC Average Life Volatility Comparison

At Time of Issuance

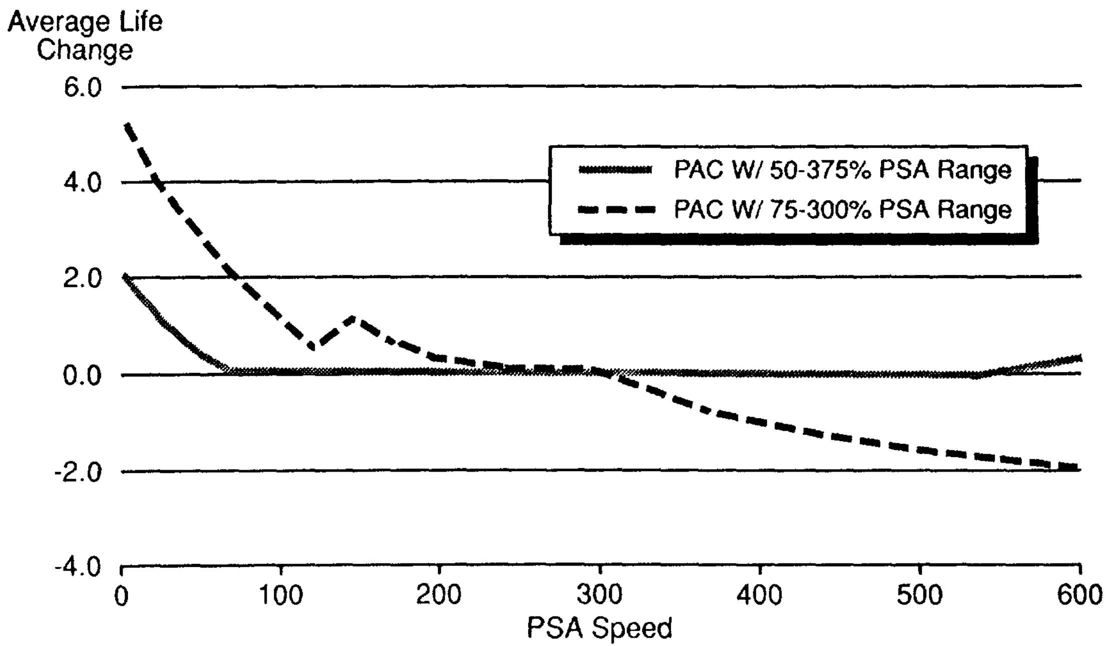


Source: Morgan Stanley

GRAPH 19

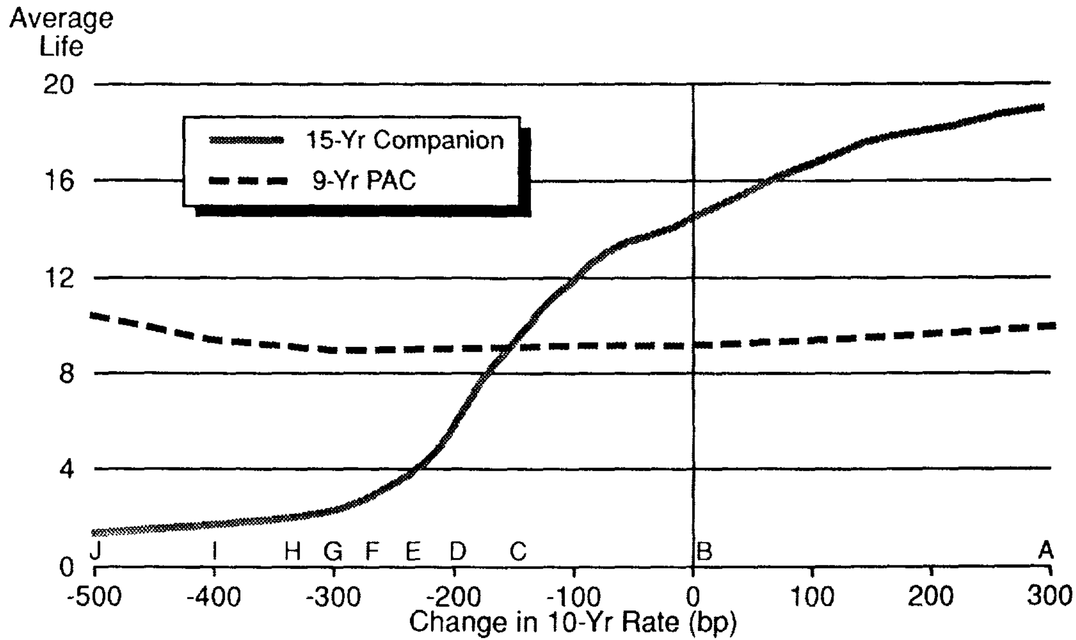
PAC Average Life Volatility Comparison

After 4 Years of 300% PSA Experience



Source: Morgan Stanley

Average Life Curves for Long-Average-Life CMOs



PSA Speeds: A=50 B=90 C=150 D=200 E=250
F=300 G=350 H=400 I=450 J=500

Source: Morgan Stanley

return its principal at the end of the PAC schedule, meaning it does not lengthen significantly as interest rates rise and prepayments fall. However, it does shorten dramatically when rates fall and higher prepayments result.

This graph plots the price performance implications of the cash-flow stability graphs we just saw (Graph 21). Holding the spread constant, the price of each class is plotted versus changes in the Treasury rate. The PAC shows a price performance much like that of a non-callable bond, again reflecting its cash-flow stability. On the other hand, the non-PAC pays much like a callable bond as it experiences price compression around 105. Basically, what started out as a 15-year bond only managed a price gain of 2.5 points for a 500 basis point drop in interest rates.

Reflecting these risk profiles, the market has obviously given non-PACs a larger yield spread than PACs. However, the higher yields can only be realized in stable rate scenarios.

The next brief example compares a portfolio of short average life non-PACs to a similar portfolio of standard classes (Graph 22). Both the non-PAC and standard portfolios have initial average lives of about 3.25 years and an initial duration of about 2.5 years. Despite the initial similarities, significant performance differences exist. The non-PAC portfolio will underperform the standard portfolio in both rising and falling interest rate scenarios.

This last example is my favorite. I think it illustrates the pitfalls of not analyzing CMOs in a dynamic and robust fashion. Recently I ran across a piece of marketing material used by a securities dealer offering a specific 7-year PAC. The basic argument this firm used was that this PAC could tolerate a high level of prepayments without significantly affecting its future cash flow stability. The dealer's analysis states that during the rally of 1986 and 1987, collateral similar to that backing this PAC experienced a maximum one year prepayment rate of 811% PSA, after which followed the slowing to 270% PSA.

The PAC had an initial 7.9-year average life for constant PSA speeds within this 100-375% PSA range. In one of the dealer's examples, one year at 811% PSA followed by a constant 270% PSA causes the average life to change by only 1/10 of a year. The analysis then goes one step further. It shows that two years of 811% PSA followed by a constant 270% PSA only changes the average life by 2/10 of a year. Based on this analysis, the dealer concludes that the 7-year PAC loses little cash-flow stability after extended periods of high prepayments.

Well, you shouldn't necessarily believe everything you read, as Graph 23 shows. What I've done is graph the change in the average life of this particular 7-year PAC as a function of PSA for the three scenarios considered: The as-of pricing scenario, which is the solid line, after one year of 811% PSA, which is the dashed line, and after 2-years of 811% PSA, which is the dotted line. Coincidentally, the average life will only remain stable if the future PSA is 270. At different PSA speeds, especially slower ones, the average life change can be fairly dramatic. Even though I know this coincidence is an honest mistake, it does point out that CMOs must be analyzed individually and dynamically and not just on a simple scenario basis.

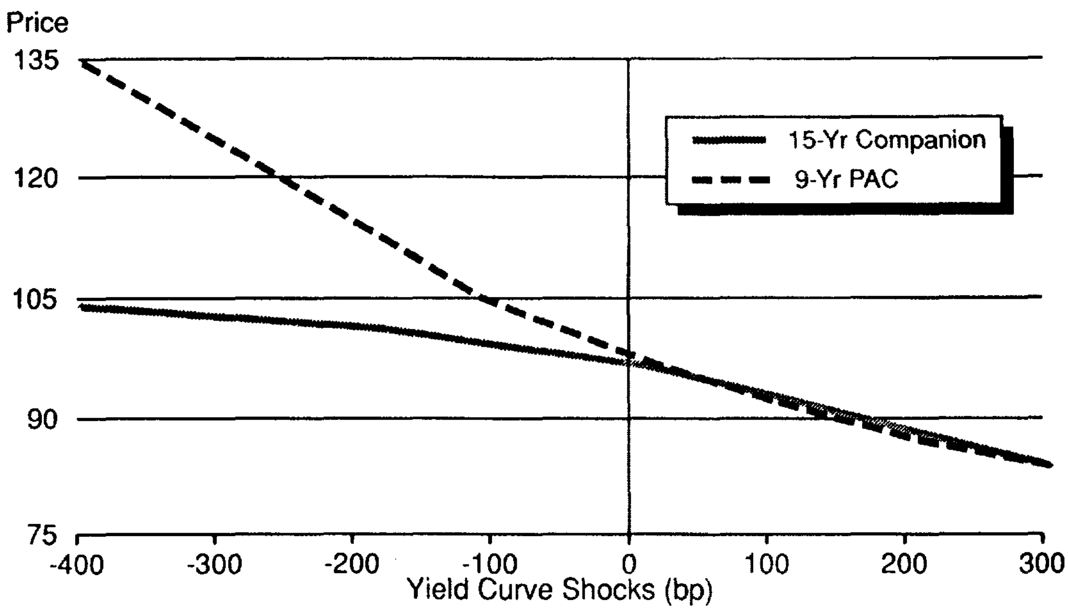
After all is said and done, I hope I haven't given the impression that all non-PACs are bad and all PACs are good. That's not the case. I just want to point out that everything is not generic, and you need to really analyze each CMO to determine the risk that you're actually assuming.

MR. STEVEN A. SMITH: I'm not sure whether this is one question or a bunch of questions. You talked about the numerous theoretical projections one must go through before buying a security to analyze what's going to happen. I guess the one concern or question I have is to what extent do you need to measure actual versus expected results and how do you do that? What kinds of adjustments do you need to make to your systems? For example, my company has the OSCARS investment accounting system for measuring bonds. What kind of bookkeeping do you need to keep track of? When you get one of those deferred interest bonds or one of those longer tranches, how do you keep track of par value? I guess this is a lot of questions. But how do you go about, after the fact, trying to measure what it is you've bought, and whether or not you actually met your objectives or what the yields are for that matter, as you start getting the cash flows in?

MR. SINDELAR: You don't use OSCARS. We've had a lot of problems with OSCARS. You basically have to use "the Street." The main problem with the CMO is that each deal is unique. The one ease of modeling collateral is that anybody can do it -- I can do it at my desk. When you

Price Curves for Long-Average-Life CMOs

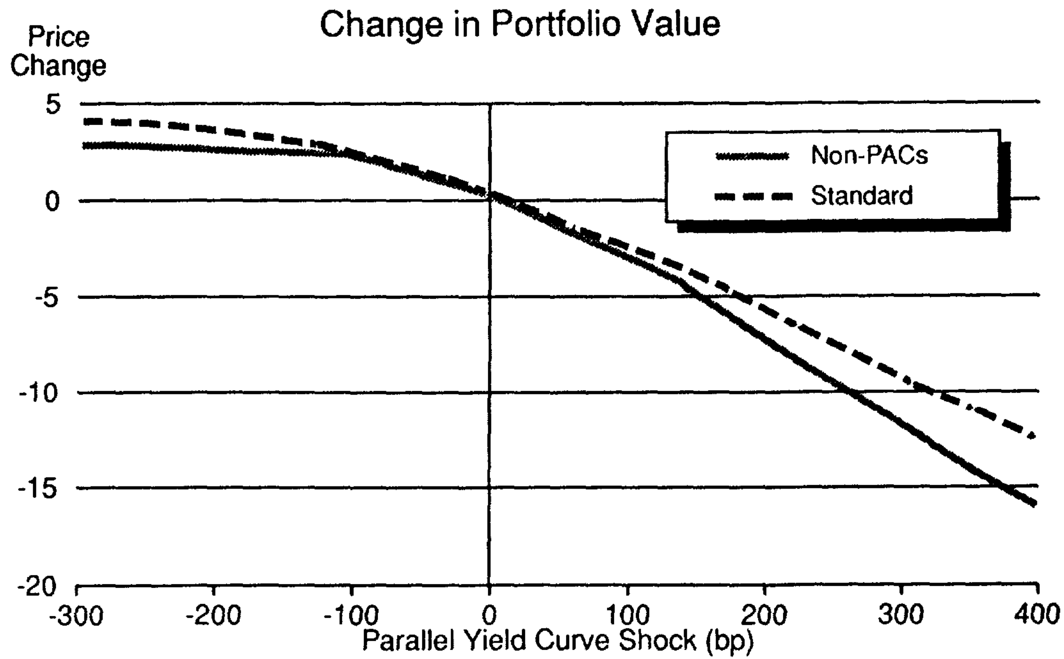
Price Holding OAS Constant with Parallel Shock to Yield Curve



Source: Morgan Stanley

Price Response to Instantaneous Parallel Yield Curve Shocks

Portfolio of Non-PACs versus Portfolio of Standard Classes

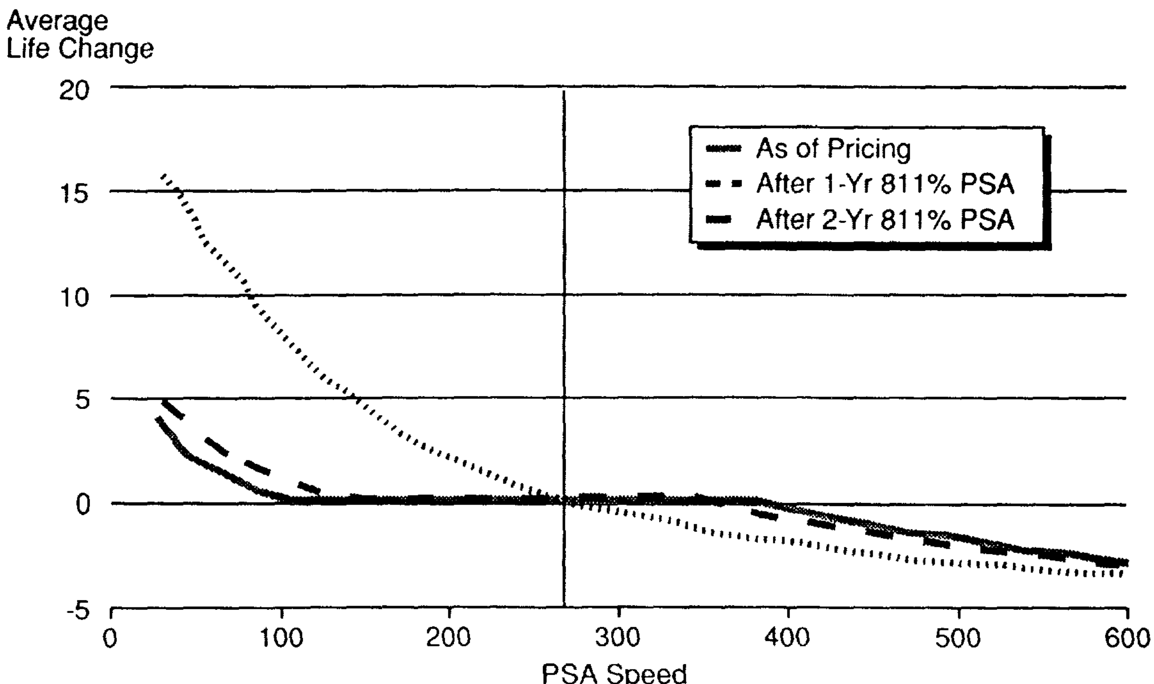


Source: Morgan Stanley

GRAPH 23

Evolution of a 7-Year PAC Protected Range as Measured by Deviation from Initial 7.9-Year Average Life

Original Protected Range = 100%-375% PSA



Source: Morgan Stanley

talk about a CMO, Salomon Brothers can do its deals and some additional deals in the Street, while Morgan Stanley can do a few more. There is not really at this point in time one source that can model the entire universe. Whole loans are hardly modeled at all. It's a big problem. That's one of the reasons their liquidity is less. That's one of the reasons their yield is what it is. When you go to the agency issued, the agency backed, more generic type of security, you eliminate a lot of these problems.

OSCARS can't compute the yield on a CMO. It has to take each cash flow under certain PSAs. I believe OSCARS can do a pass-through, but it cannot do a straight CMO, meaning you have to go to "the Street."

MR. HALL: It should be turning around somewhat in the future. A lot of people are doing a lot of work, trying to get all the CMO deals up on their systems. I don't know how many are going to have historical cash flows on them. I know that's something that we have on our list to do at Morgan Stanley so we can easily calculate historical total returns on various CMOs. There's a CMO information service known as Trepp that can give you ongoing yields, what the yield would be now at a certain PSA speed for a certain deal. In order to get what the price of it should be, now that it is in your portfolio, the best way to get that, as Joe said, is to call up two or three houses on "the Street" and ask for a bid. That will give you a good idea of what that current market value is.

MR. SMITH: That doesn't help when you're doing the Regulation 126 cash flow testing work.

MR. MOORE: I think Joe's right when he said to actually manage these specific mortgage backed security portfolios you need to use "the Street" for total return analyses and also for accurate modified duration option adjusted analysis. However, in addition to that we monitor the portfolio as to how it is behaving on a macro basis versus a particular plan. For example, if we expect that the portfolio has a duration of 4.5 years, we can determine the change in the market value of the portfolio and how the total return behaved. Frankly, I think that a lot of this kind of analysis based on what interest rates did over the last three months can be done on a personal computer using some sort of spread sheet analysis. There are some other sophisticated actuarial software systems available that do interest rate path testing, and you might want to look at those as well in measuring asset and liability actual differences.

MR. SMITH: Do you have any thoughts on getting what actually happened over the last six months or a year versus what you targeted, or how you go about updating the book yield?

MR. SINDELAR: Sure. We do that on a quarterly basis, and we're moving to doing it on a monthly basis probably at the beginning of this year. We do an actual total return based on the actual cash flows. So it's a challenge. It's not a problem we haven't overcome. We have overcome it.

As far as updating book yields, we address that on a quarterly basis. When the market moves a considerable amount, we go back and adjust the portfolio based on what actually happened. Actually we're projecting to go forward, not what actually happened.

You also questioned Z bonds. Again, this is an accounting challenge but not a difficult one to handle. The additional income is just added as another line item in OSCARS for additional par. Your accrual is just giving you that one.

MR. SMITH: So you wind up in effect understating the par value in your statement. When you look at Schedule D, Part I-A, and the maturity distribution for CMOs, these things generally are in there at their nominal 20- or 30-year duration. If you've got 25% or so of your portfolio in CMOs, the average maturity is significantly overstated.

MR. SINDELAR: OSCARS can't handle that. It does everything until maturity, and you have to override that doing everything to average life.

MR. MOORE: That's also correct for the Schedule D portion of OSCARS. Unfortunately, it won't adjust your maturities to reflect the average life.