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NEW INVESTMENTS AND NEW INVESTMENT STRATEGIES

Moderator: ALAN W. SIBIGTROTH
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Recorder: KENNETH J. EIGER

- o Investment vehicles available such as futures and options, floating rate securities, stripped securities, mortgage pools, etc.
- o Use of nontraditional investments
- o New strategies with old investment vehicles
- o Coordination with asset/liability requirements
- o Reconciliation of conflicting pressures from competition, risk level, market rates, profit goals
- o Total return on the company versus total return on the investment portfolio

MR. ALAN W. SIBIGTROTH: Our first speaker will be Gary Wendlandt. Mr. Wendlandt is a Senior Vice President and head of the Securities Investment Division at Massachusetts Mutual. He is a native of Milwaukee and resides in Somers, Connecticut. He received his BS degree in applied Mathematics in Computer Science from Washington University. He joined Mass Mutual in 1972 as an actuarial student and became a second Vice President and Actuary in the Investment Administration Area in 1981. He is also President and Director of

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three investment companies for which Mass Mutual acts as advisor. These are Mass Mutual Corporate Investors, Mass Mutual Income Investors, and Mass Mutual Liquid Assets Trust.

Our second speaker will be Jess Yawitz. Mr. Yawitz is Vice President in the Fixed Income Division, and Director of the Financial Strategies Group of Goldman Sachs, which has about 100 people in their research area. Until July, 1985, he was the John E. Simon Professor of Finance at Washington University Graduate School of Business, where he was on the faculty since 1971. Dr. Yawitz was founder and director of the school's Institute of Banking and Financial Markets. His research interests include interest rates, fixed income securities, finance theory, and he has served as an editor or referee for several academic journals. For the past two years he was also research associate with the National Bureau of Economic Research.

John Richards is Vice President with Merrill Lynch Capital Markets. He is Manager of their Financial Futures and Options area. Prior to that he managed the Futures Research for the CBOT on behalf of Drexel Burnam and he was also a cash government securities trader managing the arbitrage desk.

Our final speaker will be Robert Clancy. Mr. Clancy is Vice President in the Portfolio Strategies Group at First Boston. He is responsible for marketing structured bond portfolio products, and developing new product strategies for insurance companies and investment advisors. Prior to joining First Boston he was Portfolio Manager and Fixed Income Department head at State Street Bank and Trust Company.

The volatility growth in both fixed income and equity markets, coupled with the varied interest features assumed by insurance companies today have fueled a demand for sophistication in investment management techniques and greater asset product choices. This session will probe both the new products and the new asset management tools applicable to more traditional products. Mr. Wendlandt will discuss the issues faced by the insurance company portfolio manager. Mr. Yawitz will describe how to measure or value interest rate risk and describe some of the interesting new cash investment vehicles available today. Mr. Richards will delve into more discussion of the futures and options market, and applications of futures as a portfolio management tool. He will also discuss the

construction of a synthetic security, and tell us how to develop that process. Mr. Clancy will then wind up with a review of mortgage-backed securities under new analytical techniques, incorporating scenario simulation, and will then draw us back to asset management more generally.

MR. GARY E. WENDLANDT: I've been asked to discuss some of the current issues faced by portfolio managers who run an insurance enterprise, to set the stage for the discussion which will follow on new investments and new investment strategies. The fact that many insurance companies now have actuaries in senior positions within their investment operations, which would have been unheard of ten years ago, is certainly one indication of the changing nature of the important issues and challenges faced by insurance company portfolio managers. Likewise, the fact the Society of Actuaries is holding a meeting such as this, and is establishing an investment specialty section is certainly further indication of the changing nature of the investment side of our business.

I recall early on in my actuarial student days having been given the assignment of repricing the company's single premium immediate annuity products. This was, back then, the only nonparticipating product offered by mutual companies, and you can be sure that we were very cautious. Developing the investment component of that product was a two-step affair. My first step was to call up the company's chief investment officer and get "the rate," which at that time was 7%. The second step was to interject what was then viewed as the appropriate degree of actuarial conservatism by gently grading. How the world has changed.

What I would like to talk about is volatility. I contend that the central issue confronting insurance company portfolio managers today, and the driving force behind the innovations in the investment world, which is the topic of this panel, is volatility. I will discuss the signs and symptoms of our volatile financial world, and some of the consequences of that volatility on our operations. Finally, I will discuss some of the organizational issues which are raised as one attempts to deal with this condition.

Before getting into the main thrust of my arguments however, I think it is important to draw a distinction between two types of accounts managed by insurance company investment operations. The first type of account we call a

performance primacy account. Examples of this would be the separate investment accounts offered to pension clients, where the investment risk is borne by the client rather than the company. Mutual funds wrapped by variable annuity and variable life insurance products would also fall into the category. The focus of the manager of these performance primacy accounts is to perform, which could simplistically be described as beating the market.

We call the second type of account a liability primacy account. Examples of this would be segments within the insurance company's general investment account, where the focus of the portfolio manager is on managing his assets in relation to the liabilities being supported. In these cases, the manager is first and foremost driven by the liabilities. If, for example, one is managing a GIC portfolio where the primary focus is to satisfy the guaranteed liabilities with a high probability under a variety of possible futures, it would be a liability primacy account.

My comments are primarily directed at these latter types of accounts. These accounts present challenges and opportunities unique to the insurance company portfolio manager. At the same time, they tend to have a predominant fixed income focus, which is in sync with the topic with which our panel will be dealing this morning. The majority of the innovations which have taken place during the current wave have taken place in the fixed income markets. Likewise, the manager of this type of account typically has greater flexibility and can deal with a wider range of alternative investments and investment strategies.

With that as background, let's talk about volatility. Financial deregulation and globalization of markets have made the world a volatile and hostile place to play. It's a jungle out there. And as with any jungle, when you go out for your morning stroll you may think that you're the predator, while you may end up as lunch.

It's impossible to turn on the evening news these days without directly confronting the volatility of the stock market. The DOW is up fifty points one day, and down sixty the next. Perhaps less obvious, but certainly of more concern to the insurance company portfolio manager is the volatility of our fixed income markets. In actual fact, the long-term bond market, which was our mainstay but ten years ago, has exhibited equal or greater volatility than the stock

market throughout most of this decade. Table 1, which compares the volatility of the S&P 500 stock index to long-term treasury bonds, clearly points out the fallacy of the notion that bonds are safer than stocks, at least over the short run. Likewise, the recent 175-basis-point run-up in the long government interest rates over a six-week period reminded me of the volatility of the early 1980s.

Table 1

VOLATILITY

	Long-Term Treasuries	S&P 500 Stocks
1980	20.1%	16.4%
1981	19.4	13.8
1982	15.6	18.1
1983	10.2	12.9
1984	11.0	12.7
1985	10.5	10.1
1986	15.3	14.5

The other side of fixed income investing -- namely credit -- has shown similar instability, and here I would argue that the worst is yet to come. While the optimism engendered by being in the fifth year of an economic recovery has created an environment where financial accidents are taken in stride, it is at least interesting to note there were more bank failures in 1986 then in any year since the Great Depression. The fragile, unstable, and potentially volatile nature of this country's credit structure is evidenced, at least in part, by the ratio of nonfinancial debt in this country to total Gross National Product, which averaged approximately 140% for the three decades prior to the 1980s and now stands at approximately 180%. Likewise, the farm economy is in a depression, with foreclosure rates exceeding 25%. And real estate appears on the verge of entering into what could prove to be the worst downturn in many years.

An obvious symptom of volatility, as well as a potential cause, is the pace of activity in the trading mentality which has replaced the peaceful buy and hold of the past. At Mass Mutual, for example, we traded over $10 billion worth of bonds last year, which is an amount greater than our entire bond portfolio, and I would expect that we are about average in the industry. And the once gentlemanly private placement market was recently described by a participant as being "like throwing raw meat to a den of hungry lions." The old saying is that no one trades a flat market. Volatility creates the situation where an investment

that we like today may be entirely unsuitable tomorrow, and the result is that an enormous volume of trading takes place.

In order to facilitate both this need to trade and this mind-set, we have witnessed the creation of new investment tools, innovative investment instruments, and new strategies. The whole phenomenon of securitization and packaging of residential loans, automobile loans, and I guess one of these days even policy loans, is all intended to allow the trading and retrading of assets which arguably were intended for the originator of the loan to keep. We now even make markets in loans to Brazil. And like a game of musical chairs, it will be interesting to see who owns what when the music stops.

Likewise, some of the solutions to the problems caused by volatility can also exacerbate volatility. There has been much written in the press recently about a new investment strategy being used by pension plans that are invested in the stock market, known as portfolio insurance or dynamic hedging. While hard evidence is hard to come by, from my perspective as someone who manages portfolios utilizing these strategies, it is reasonably clear that the execution of dynamic hedging strategies, which are designed to protect against some of the volatility in the marketplace, actually can increase the amplitude of the swings in our markets.

What are some of the consequences of volatility? Clearly the most important result of increased volatility to the insurance company portfolio manager is that options take on increased value. It is beyond the scope of my remarks to discuss option pricing theory, but I commend to you any of the many treatises which have been written on the subject, for I think this is a subject that few actuaries can afford to ignore in today's volatile environment. Suffice it to say that the value of an option is directly related to the volatility of the underlying instrument.

This fact frames our central issue in its importance due to the fact that insurance companies have traditionally and historically positioned themselves on the short end of the option stick. We have grown up in a world where it has been customary for insurance companies to grant options to others on both sides of their balance sheets. And the presence of these options has been exposed by the volatility of our financial markets much to our detriment. Guaranteed cash

surrender and policy loan provisions, after all, are really nothing but put options whereby our policyholders can demand payment at par on policies whose underlying asset values may be well under water. Likewise, the so-called window guaranteed investment contract (GIC), which is used to accept periodic deposits under defined contribution pension plans at guaranteed rates, is really a call option, whereby plan participants can purchase a participation in a rate for a fixed term, which may represent value above that currently available in the marketplace.

The most notable option on the asset side of our balance sheet involves the callability of our assets. We have, at least at times, granted to our borrowers the right to repay loans which may have interest rates far in excess of prevailing market rates. We may also have, through inadequate protective covenants built into our loan agreements, granted borrowers the option to change the nature of the enterprise to which we make the loan through merger, increasing C-1 risk, and again working our detriment.

As a consequence of this volatile environment in which we, as insurance company managers, find ourselves, we have developed a heightened awareness of the options we have freely given in the past. We should, and perhaps must ask ourselves several questions. First, what is the cost of taking risk? It is far too easy in today's competitive world to focus on the potential benefits of taking risks in terms of sales, profitability, or growth. We need to know what the costs are, and some of the newly popular tools such as option pricing theory give us the wherewithal to do this on a much more scientific basis than in the past.

Second, for what risks do I get paid? We need to know what risks the marketplace will let us build into the price of our products, and I would argue that we can no longer afford the luxury, given a hostile and volatile world, of accepting risks for which we are not paid, as we might have done in the past when the cost of assuming certain risks was much less.

Third, what risks do I wish to shed? Prior to deregulation, and in the current wave of financial innovation, our risk profile was largely determined for us -- we simply intermediated our deposit base into our loan portfolios. Today we have available to us the tools to adjust our risk taking, to shed risks that we

choose not to bear, and to diffuse options that we grant along the way. In so doing, we define the very nature of the business that we are in, and each of us may do so differently, in ways tailored to our own strengths and weaknesses.

Finally, what are the costs of shedding risk? Here again, the presence of new investment instruments and strategies provides us with the means to price, in advance, and with some degree of certainty, the cost of shedding various interest rate, option, and credit risks, much as we have done for years with the catastrophic mortality component through reinsurance.

The answers to these questions must be urgently sought, and I would suggest here that this is primarily an organizational issue. These are not questions to be answered by the portfolio manager. Nor can they be answered solely by the actuary or the marketing department. What is required, in my opinion, is a joint effort among the various parties, involving teamwork, and effective communications to insure that optimal solutions and strategies are developed.

Such a process should result in the creation of strategies which blend the organization's traditional strengths with the need to alter the way things are done in a volatile, fast paced, and innovative environment. An example might help. As with most large insurance companies, Mass Mutual's investment operation is organized along functional lines. We have a Real Estate Division which handles our mortgage loan and real estate activities, and we have a Securities Division which handles our stocks and bonds. Both of these divisions are staffed by experts in their field, and the record would indicate that they are fairly good at what they do. With the structure, however, an obvious question is, who is responsible for mortgage securities? Add to the problem over the name the fact that many of the risks associated with these instruments are more susceptible to mathematical and actuarial analysis than to what I would call traditional investment analysis, and you have a real mess on your hands. Yet the opportunities to use these multifaceted and often inefficiently priced instruments to redefine the risk posture of a company are enormous. We have been active buyers, sellers, and even issuers of all types of mortgage securities and derivative instruments over the past several years, and we have accomplished this organizationally by focusing our traditional strengths in mortgages, securities, and actuarial science with a new spirit of teamwork, cooperation, and communication.

In more general terms, the combination of a highly competitive and volatile environment with an unprecedented pace of innovation presents both opportunities and challenges. In order to succeed in capturing the opportunities, and to turn ourselves into the predator, we need to build capabilities and devote resources to the analysis and implementation of new investment vehicles and innovative strategies. This requires that we bring to bear both the technological tools and the human capital needed to do this thoughtfully and carefully. And finally, we must insure the adequacy of our management systems to control and monitor activities which are largely alien to our traditional ways of looking at things. Without this capability we will be somebody else's lunch.

In summary, I would define the central issue and concern facing insurance company portfolio managers today as volatility. This volatility has exposed the options on our balance sheet, and caused them to take on increasing value. At the same time volatility has bred innovative investment tools such as duration, convexity, and option pricing; new investment vehicles, such as swaps, strips, options, and futures; and new strategies such as hedging, dynamic hedging, and immunization, any of which can be used in the right circumstances to respond to the environment with the focus of managing, controlling and shedding risk. Finally, the effective organization of the appropriate resources is a key to our success.

MR. JESS YAWITZ: What I'm going to try to do is make a few comments that will attempt to integrate the new innovation process and the proliferation of new fixed income securities. The key concepts that were mentioned already, namely volatility and understanding options, or imbedded options, will come up numerous times, not only in my comments, but throughout this session. The manner in which I will attempt to do this is not to dwell necessarily on particular innovations or particular bond structures, although I will have a few things to say on perhaps one or two, but to try to describe this new environment. Whether we described it as volatility, or as an environment in which those of us who are in the financial markets have seen fit to create these new securities with bells and whistles, isn't of issue.

As I try to describe the means by which that proliferation of new instruments has complicated, or put another dimension on the entire asset/liability question, and as this innovative process continues, in general I give the financial markets

reasonably good grades over the last several years in terms of creating new securities that are designed to meet constituencies on each side of the balance sheet. There are certainly some trendy new innovations where we see one or two issues coming to market and then dying a natural death. I think the story that describes these types of trendy issues is that there was a point in time, or window of opportunity, whether it was driven by the swap market, synthetics, or something else, that made those issues acceptable and gave them a niche at a given point in time.

What we try to examine is enduring types of new innovations, which are created when there is a natural buyer and a natural issuer. I think this comes back to the central theme of much of what many of us will be saying here today, and that is from an asset/liability point of view, whether one calls it match funding, gap management, or a duration based approach. By the way, I don't consider these points of view to be competitors, but rather as compliments to each other. Much of the interest from the buy side in securities other than ten-year noncall life bullets seems to be driven by, and should be driven by, this general asset/liability risk management perspective. I think also that the interest from the issue side, which isn't represented here today, is that a product makes sense not just because it's a cost effective source of money, because that type of cost effectiveness is a type of a zero sum game among the underwriter, the issuer, and the investor, but that it makes sense from an asset/liability point of view.

I'll just describe to you my frustrations over this innovation process, and maybe it depends on whether the optimist or the pessimist in me wakes up in the morning. There are times when I view the enhanced menu of fixed income securities in a manner similar to how a painter views the various media in which he can work. As there are currently now a lot of opportunities, there is also a return to prudently doing one's homework and understanding the impact of the imbedded options on the performance of the various securities.

Now that's nice to say, and there is no question that if one does understand these exotic securities, and when I talk about *exotic securities* I don't necessarily mean very strange bond structures, then the risks can be better understood. An example of an exotic security that does not have a strange structure is a ten-year noncall five in a market in which market interest rates are changing significantly. Look at the most recent bond rally, when many of us had

what we thought were low-coupon securities, and said most likely these securities would go to their maturity dates. Well, lo and behold when the market rally is 300 basis points, this bond changes personalities. Instead of in the greatest likelihood being a ten-year security, it becomes a five-year security; i.e., it trades to its call date. So there certainly is a return to understanding and comprehending the features of this particular security with its imbedded option, and what it brings to the party and to the balance sheet.

Sometimes the pessimist in me says there are all these accidents just waiting for a place to happen, and the accidents on Wall Street are well known. Whether these problems are in terms of comprehending the mathematics or the price behavior of these securities, and I think that's the same thing, or whether it's our inability at this time on Wall Street to hedge some of these exotic positions is beyond the scope of my remarks today, but I think that we don't have the ability, or the option to say "I won't play" in these securities. None of you really does. We at Goldman Sachs in our role as underwriter and investment banker don't have the ability to say we are now in the trading and new issue business only for noncall life securities. I think that's the same situation in which all of you find yourselves, in that you can't just throw up your hands and say, "I don't want to take account of volatility. I'm not really interested in why it is that when there is more volatility in options on futures that there also happens to be a widening of spreads between current coupon mortgage securities and treasuries." You just can't put your head in the sand because there just isn't enough noncallable paper around, and as Gary indicated, people who are in your business either by design or necessity like balance sheets with a lot of options. You tend to be a writer of options, and you tend to write volatility into the marketplace. Whether that's because the yield or cash flows tend to be greater, or whether you think that's really a necessity in order to participate in the markets is a subjective question to which each of us has our own answer, but it is a fact of life that the great majority of securities have characteristics in them that can change the profile of the cash flows dramatically. I think that it's these characteristics that cause us to spend a lot of time and resources on understanding these bonds with their imbedded options.

Going back to the asset/liability perspective, or asset/liability point of view, when I first became involved in this area in the early 1970s, the focus, at least my focus, was on who had the best computer software. From the asset/liability

perspective, if one were to formulate the cash flow profile from a prototypical financial institution's balance sheet, the question of how I wanted to present or analyze that data was very important in terms of just literally the software and the manipulation of the data, and I think that's less important now for two reasons. The first is that we've made strides in terms of computer systems/ software development, and I think most of us are of the opinion that in the early and mid-1970s we got carried away with this proliferation of dedicated bond portfolios, cash match portfolios, and immunized portfolios. We said, "Wouldn't it be nice if we could take an insurance company's balance sheet and run out the cash profile, cash inflows and cash outflows, do some rebalancing on the asset side, put together something that looks like a cash match, and then, in a manner of speaking, stick it in a desk drawer?" This approach is in a manner of speaking the slam dunk -- locking in a spread, and I won't even dignify the importance of making that mistake which many of us made. The world just won't permit that approach in 1987, whether it ever did is probably open to debate, but this idea of viewing the balance sheet of a financial institution as something that is amenable to a view as a dedicated bond fund, a global or very complex type of dedicated bond fund or cash match, is really out of the question.

An example of this type of analysis is that if one owns a ten-year noncall five, which means an issue that is callable at the end of five years, that is a current coupon par bond, maybe it's approximately 50/50 that it will be a ten-year bond, and 50/50 that it will trade like a five-year bond. To recognize this, one would give it the characteristics of a 7.5 year bullet. Now be very precise in running out those cash flows on the asset side, so I've got the coupons for 7.5 years and then the par payment. The problem with that approach is, if you think about it, what is the probability after the fact that that bond is going to go exactly for 7.5 years, so its maturity is 7.5 years? Very, very improbable. The most probable situation is that it's either going to be called with the call at the end of five years, or that it's going to go full term to maturity, in the event that rates have gone up. The term I use for much of this focus that we used to have on being very precise in quantifying cash flows is that it was a hypnotic precision. You spend a lot of time generating cash flow patterns, debating whether you wanted to use a duration based approach or a gap management approach. (I don't know if those are generic enough terms that we feel comfortable with them) and produce a hypnotic sense of being matched. In this context when I refer to the gap approach I mean that we will run out all the

cash flows and then we'll slice the future into maturity buckets, with the first six months net of all asset and liability inflows, the next six months, maybe the following year, and so on. We get a very precise pattern of what the net inflows and outflows look like and that can be useful.

The results of this gap approach, which is also called the margin approach, or the cash flow analysis approach, can be very useful in indicating where there are pressure points in the future. Pressure points in this sense mean that, for example, I may have a very large bond issue on the liability side that is funds due to maturing assets during a particular three-month period, which subjects me to significant reinvestment risk. We don't want to dismiss this kind of cash flow pattern; I'm a big believer in the usefulness of pictures. But there is more to it than just running out this cash flow pattern because it's very difficult to develop cash flow pictures that properly account for the option characteristics in mortgages, in window GICs, and in all of the other various assets and liabilities that are of a nondeterministic nature on your balance sheet.

On the other side of these is a duration based asset/liability management model. What we do under this method is try to collapse the entire complex balance sheet into a measure of what the duration of each side of the balance is. In this context duration is a measure per basis point change in interest rates of what will be the resulting price change on each side of the balance sheet. The one advantage of a duration based model that is very difficult to get out of these cash flow models, is that the duration based model is better able to accommodate quantifying, doing your homework, and measuring the impact of options. For example, if I have a ten-year noncall five in an environment where interest rates are significantly higher now than when the security was issued, I can treat that security as almost the ten-year noncall in terms of what it brings to the duration equation, which is probably pretty close to correct since securities are not likely to be called if rates are a lot higher. If the market rallies and rates begin to come down, I can easily adjust the contribution to the balance sheet that that one security is bringing to me. It will begin to trade more and more as a shorter security, if interest rates are significantly lower than the coupon; perhaps the best guess would then be that it's going to trade as a five-year security. What I'm saying is that impacting or quantifying the effect of these option type of securities on the balance sheet is significantly easier when one is using a summary measure for asset/liability management like a duration based

model, than if he were going back to the primary, or individual cash flows, since then he would have to make a judgment as to what the most likely outcome is if he were trying to generate cash flows for a security or for a portfolio.

As far as the optimistic and pessimistic points of view, I don't know how you are split. It may depend on how the market did before 10:30 this morning. But there is no question, on the asset side, that the menu of fixed securities or fixed income investments that you can buy and swap is a much broader menu then it was last year, and it's a much narrower menu than it will be in six to twelve months.

There are really two approaches to this menu of choices. The approach with which I happen to agree is that if one doesn't understand the product then he shouldn't play in that game. If the particular product is so generic that it's a security with option characteristics, or a security other than these vanilla non-call life bonds, then he is pretty much shut out from the marketplace. It's the first step that should be taken by anyone who hears from an issuer that he's got a new financial instrument which has bells and whistles, and is really cheap. If you don't feel comfortable with the valuation, I don't have to tell you what my reaction would be as far as whether or not I would put my money into it. But in terms of putting in the time and energy to understand these bells and whistles in the bond structure, the returns can be very, very significant. The returns can be significant in terms of enhanced performance from a rate of return perspective, and also many of these instruments bring very interesting hedging characteristics to the balance sheet. Whether it's very difficult to quantify option characteristics like the interest only/principle only (IO/PO) pieces or even less severe mortgage strips in general, or whether it's an inverse floating rate note, (the so-called yield curve notes that bear a coupon rate of, for example, 17.2% minus London Inter Bank Offered Rate (LIBOR) five-year final) the hedging opportunities are brought to the balance sheet.

The second approach would be to say that "if the security trades cheap relative to its theoretical value, then maybe there is a way to capitalize on that. An example of this is that if you had one of these inverse floating rate notes and then would undertake an interest rate swap where you paid a fixed rate, and received a floating rate, then you would, as a result of this swap, end up with a fixed rate investment where you would draw a circle around those two. What

this shows is that sometimes you can take an esoteric product, add another fairly esoteric product, put a circle around the two, and end up with a vanilla bond. If you can take a security that is selling cheap in the market, say the five-year inverse floater, undertake an interest rate swap, and end up with a five-year fixed security at a wider spread than where that credit should be for a five-year noncallable bullet, then you have capitalized on the market, and you've taken advantage of the fact that you understand that structure. There are hosts of opportunities out there that, depending on whether we want to spend the time to evaluate the security, depending on whether we want to monitor its performance, depending upon whether we have the facility to combine a cash bond with an interest rate swap, with a cap, with a floor, or with a collar. There is an enormous return in terms of rate of return and enhanced performance to doing one's homework, and in feeling comfortable with these new innovations.

In conclusion, I would submit that if you really are taking asset/liability or balance sheet management seriously, and that if you accept my hypothesis that the world is such that we cannot elect to throw up our hands and say "I won't play in these option securities," then there is only one solution. That solution is that you have to do the analysis, you have to do the arithmetic, and you have to do the homework. I think that's really the message that comes from what many of us on the panel are saying, and that's the message that comes through loud and clear. Whether it's to look at volatility over the last 10 years, whether it's to look at embedded volatility and options for what we are looking at today, the message is that there is a return simply to doing one's homework and understanding innovations.

MR. SIBIGTROTH: Jess, I'm wondering if you could capsulize for the audience a definition of the duration or gap approach. I'm not sure all of the people in the group are familiar with the distinctions.

MR. YAWITZ: When we talk about the duration approach, we look for the answer to the following question. If I sold all the bonds and bought a single zero-coupon treasury strip, what maturity of that treasury strip would I have to buy so that the price responsiveness of that zero-coupon bond per basis point change in interest rates was the same for the whole portfolio? Suppose the answer to the question is the duration of this whole complex bond portfolio is

five years; that says that the portfolio of long assets and short assets has the price action per basis point of a five-year zero-coupon bond, and the price action of a five-year zero is approximately that if rates rise 100 basis points it will go down in value 5%. So duration is really a shorthand way of describing what the price action would be either on a single asset or a portfolio of assets.

When we talk about a duration mismatch between the assets and liabilities, if the duration of the assets is longer than the duration of the liabilities and interest rates rise we would have a greater price deterioration (loss) on the assets than the gain that we would have experienced on the liabilities. So, duration is a way of collapsing a very complex balance sheet into a single number.

The gap approach, on the other hand, says let's run out all the cash flows on the assets and liabilities. And one thing I'd be interested in over the next six-months is how many assets are maturing that are subject to repricing, meaning that I need to reinvest those cash flows, versus the number of liabilities coming due that are subject to repricing, meaning that I have to reborrow. And if the number of assets exceeds the number of liabilities coming due it means that I am a net investor during the next six months. If you take six-month intervals from now until the end of time, or until the balance sheet that you have were to run out, do that six-month gap analysis, and add up all of those gaps, you would get an answer that is analogous to what I get from duration. One of them is just a more precise quantification of the time profile of this duration impact or duration difference. So, it's really a flow analysis versus what we call a stock analysis or a single index of performance, and I view these as complimentary approaches to balance sheet management as opposed to competing ones, although I think many of us in the financial markets view them as competing approaches. I also think that most of us would want to do parallel analysis on both the gap and duration approaches.

MR. JOHN A. RICHARDS: I've been to and spoken at many seminars, and I imagine that many of you have too, that go into the basics and even some of the more sophisticated uses of futures and options and derivative products. It's probably one of the seminared-to-death topics in the world, and I thought that rather than belabor the basics what I'd like to focus on is something quite specific, and focus on it in the context of a very specific example. What I'm going to discuss is the process of using synthetic securities for yield

enhancement, and I'd like to focus on the process of looking at specifically creating a synthetic alternative. By a synthetic I mean a combination of cash securities and, in this case, a futures position to replicate certain properties of an underlying cash security, in this case the strip. We are going to look at the possibility of replacing a strip in a portfolio, and seeing if we can enhance the yield on that portfolio. This is not a trade that I am per se recommending, although it's a fairly attractive looking trade. What I want to stress is that I'd rather focus on the process of creating this trade.

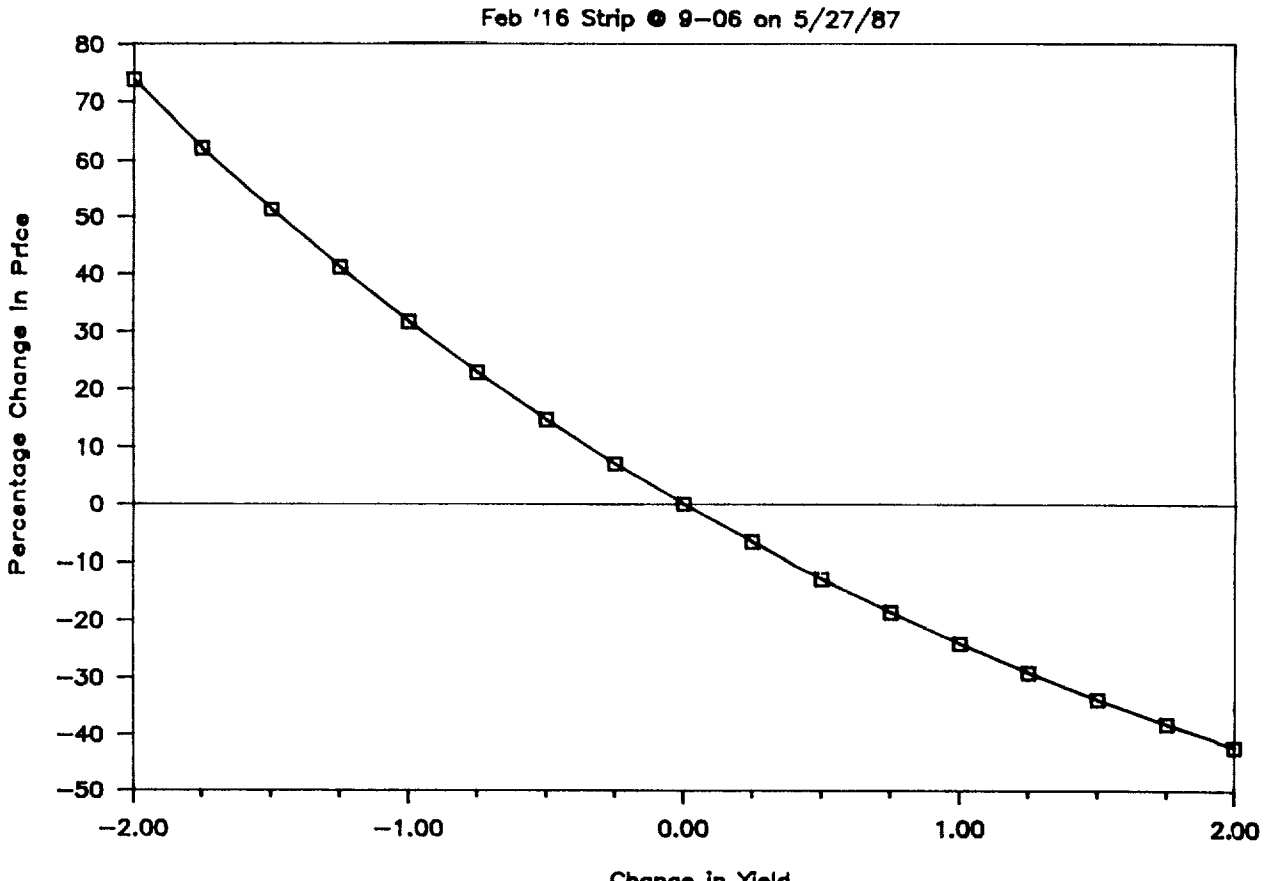
Let's begin by defining what is meant by yield enhancement. Essentially a synthetic security is said to enhance a portfolio's yield if it provides a higher return at the same level of risk as an existing security. But if we are going to further operationalize that definition the fundamental questions, are what do we mean by risk? How are we going to quantify the risk in the security? Well one measure of risk is its duration, and I think that Jess has just helped me out by defining what we mean by duration, whether it's the duration of individual security or the duration of an entire portfolio.

Essentially the duration measures the sensitivity of the security's value to a one-unit change in its yield. In this case, the duration of the security would be the slope of the line shown in Graph 1.

If we are going to talk about the duration matching security at a point in time and at a given yield, what we are talking about is finding an alternative security to the one in question that has duration properties like that depicted by the strip shown in Graph 2, essentially which has the same duration at a point in time and which offers a higher yield. Geometrically, the synthetic strip shown in Graph 2 is the second security that we are considering, and what we want to do is construct that second security so that at the 0.00 coordinates, its duration line is tangent to the duration line of the first security. Now, again, geometrically, if the second security has a higher yield, (higher return) than the first security at the 0-0 coordinates, which is the starting point of our analysis, we could replace one with the other, and improve the performance of the portfolio. What this shows is a very rigorous definition of what is meant by creating a synthetic security to enhance yield.

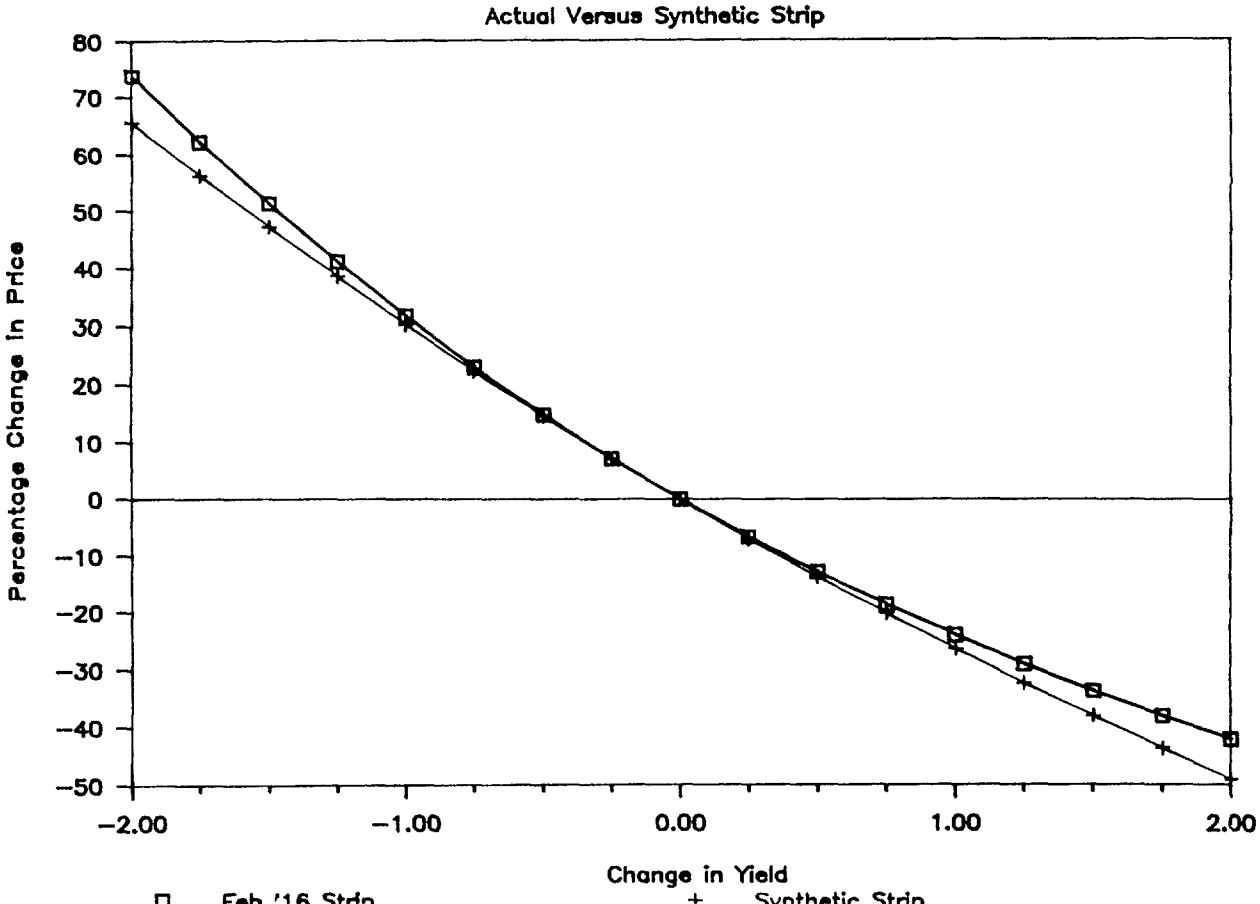
GRAPH 1

RISK AND DURATION



GRAPH 2

RISK AND DURATION



Let me turn for a minute to stripped securities. Essentially a strip is a zero-coupon security, a security in which the coupon payments have been stripped away and that's sold as a principle payment at maturity only. They certainly have been useful to portfolio managers in a number of ways, specifically to extend duration beyond that offered by the longest cash market treasury, for example, or in a dedicated portfolio to ensure that the income would be there to match the needs of a future liability. This is the reason that strips appear in the portfolios of many investors. Now a relevant question seems to be What's the cost of achieving the benefits that a strip gives us? A related question might be, Can we find another security, in this case a synthetic, which matches the duration of the strip, so that it has the same risk properties as the strip, but which can be put into the portfolio at a lower cost, i.e. doing what the strip does, but offering a higher rate of return?

The specific example that I want to consider is buying 100 million of the Treasury 2016 strips at a price of 9 points and 6, for a total investment of a little over $9 million. Alternatively, and this is the process of creating the synthetic security, consider investing the same amount of money, a little over $9 million, in 6-month Treasury bills for a return of 9.39%, and then start adding futures contracts until the duration of the stripped security has been replicated. The duration is 28+years, so futures contracts will be added until that duration has been achieved. It will take 299 December Treasury and futures at a price of $89.25. In my analysis I disregard initial margin and variation margin as prices move up and down, but those could be factored in later.

One can ask, What is the annualized six-month rate of return of this synthetic security versus the strip under various interest rate scenarios? The first place to start is the 0.0 coordinate, which is in the middle of Table 2 for yield change. The stripped security (the zero-coupon security) has a return over the holding period in the standstill environment of 8.4%. The synthetic security has a standstill return of 20.6% for an enormous pick-up in yield of 12.2%. This pick up in return makes the synthetic appear to be a very attractive alternative. The issue that's important here, as Jess said, is that when you are shown investment alternatives like this you must further analyze the risk.

TABLE 2

ANNUALIZED SIX-MONTH RETURNS

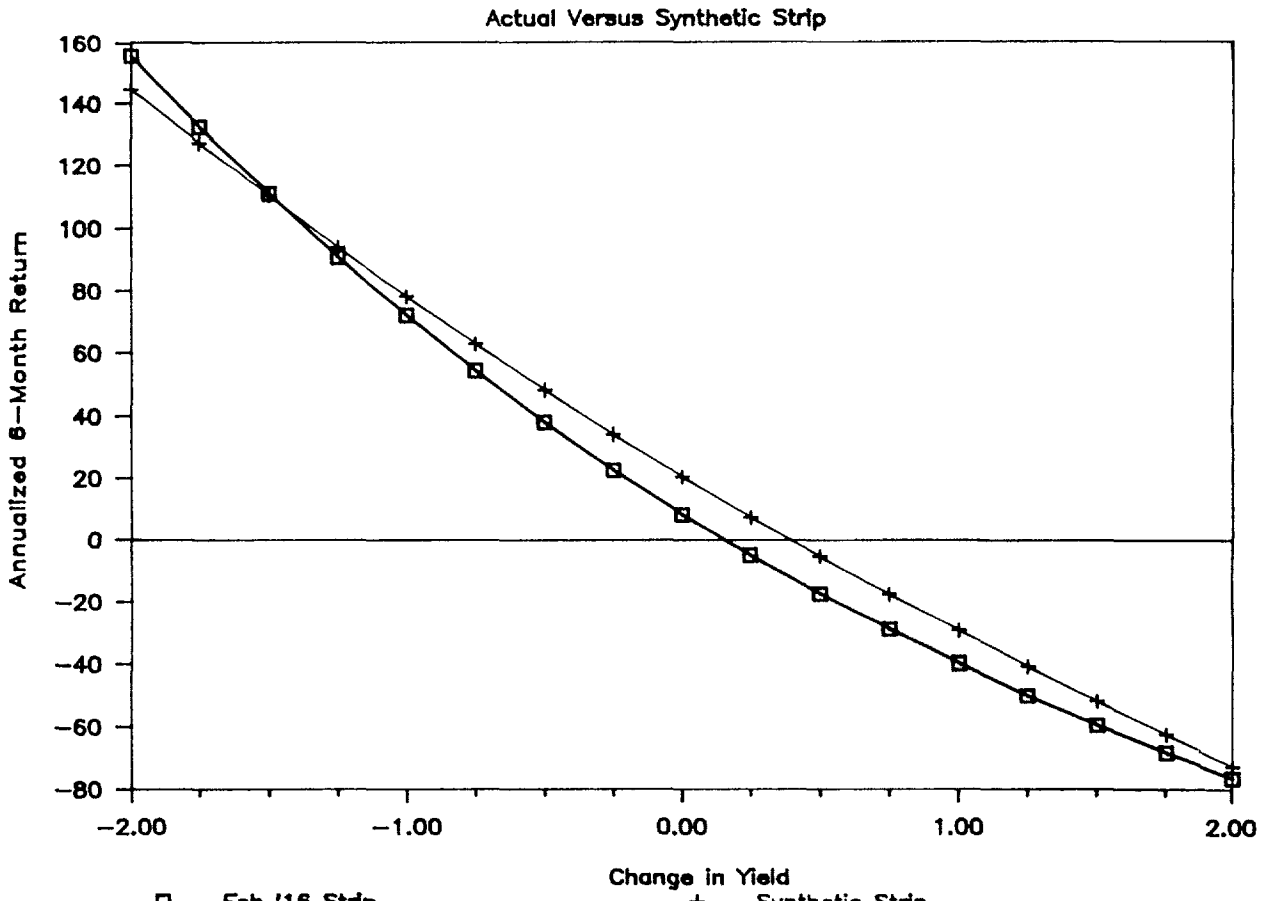
Yield Change	Strip Return	Synthetic Return	Difference
-2.0	155.7	145.0	-10.7
-1.5	110.9	110.3	-0.6
-1.0	71.9	78.2	6.3
-0.5	37.9	48.3	10.4
0.0	8.4	20.6	12.2
0.5	-17.4	-5.2	12.2
1.0	-39.9	-29.3	20.6
1.5	-59.5	-51.7	7.8
2.0	-76.5	-72.6	3.9

What I'd like to do now is look at some of the risks in purchasing the synthetic security. The first component of risk is what I call convexity risk. To analyze this risk we assume that there is no change in the relative cheapness of the futures contract compared to the cheapest-to-deliver security, which its price typically tracks; that there is no change in the yield spread between the cheapest-to-deliver security and the strip; and also that the futures and the cheapest-to-deliver security retain the same pricing relative to one another (that is, there is no change in the implied repo rate that would represent the relative value of those two securities). Under these assumptions we change the yield, and see the responsiveness of price in each of these securities to changes in yield. When one does a scenario analysis over a six-month period and moves the yield up and down, it can be seen in Graph 3 how the returns vary, and that the synthetic security has a positive pick-up over the stripped for a very wide variation in yields. We say that the strip has more positive convexity than the futures (the synthetic security), and in that environment, over very wide ranges of yield changes, eventually the strip will begin to outperform the futures contract. So if we are in an environment where rates are expected to move very, very widely, this strategy will not perform as well as it would in a relatively standstill type of environment, and this is due to the different convexities of the two securities.

There are ways that you can offset convexity risks, such as by adding options to the portfolio. Specifically, for decreases in yield and increases in prices you can be long some deep out-of-the-money call options, and for the reverse you could buy some deep out-of-the-money put options. The premium on those

GRAPH 3

SCENARIO ANALYSIS



options would be an offset to the return that the synthetic security would give you, but that can easily be factored in.

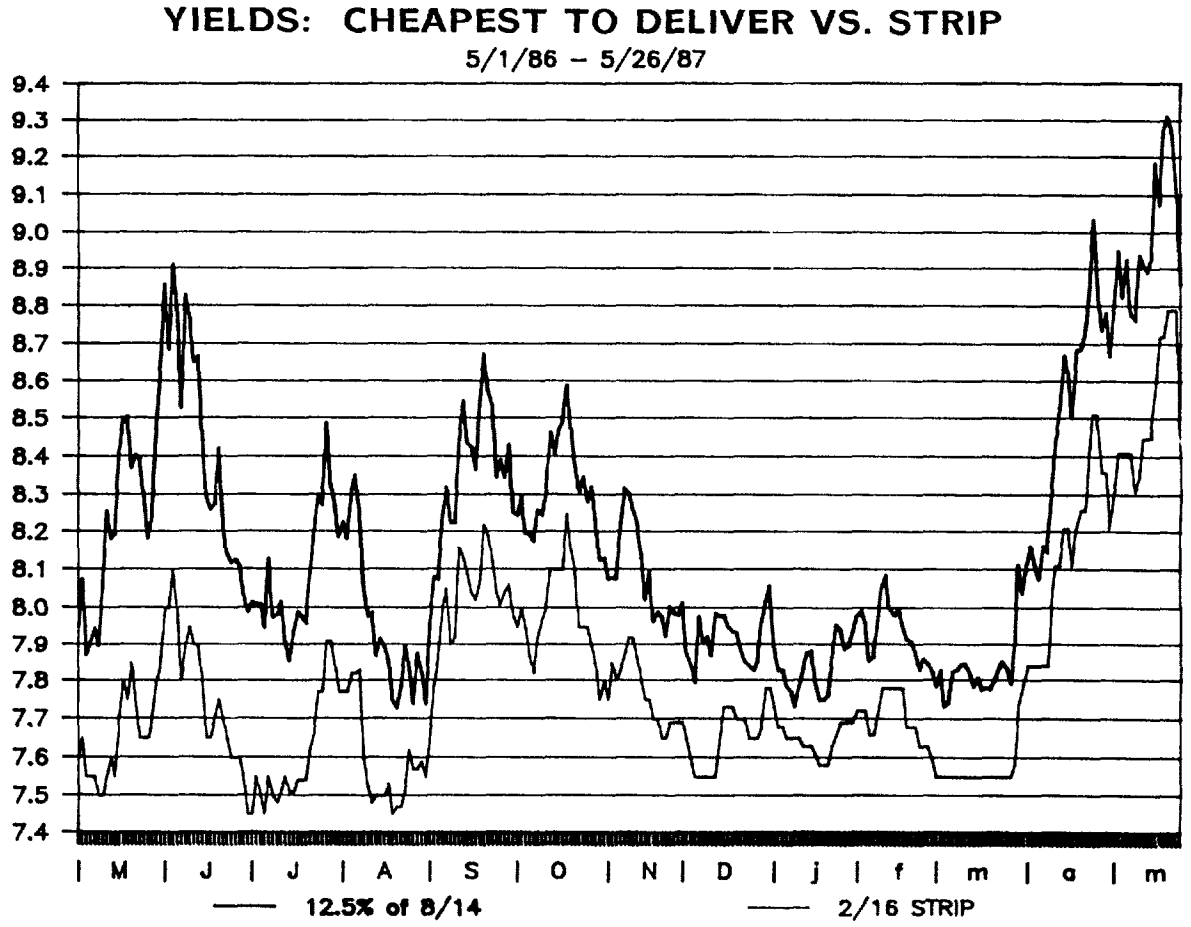
The second source of risk in being long this kind of security is yield spread risk. What we are assuming in Graph 4 is that the futures contract is pricing off the cheapest-to-deliver cash bond, in this case the twelves of 08 represented by the upper line. What this chart shows is the yield of the twelves of 08 and the strip, because that yield spread will have an impact on how the futures track relative to the strip, if indeed it is pricing off of the twelves of 08. You can see just by eyeballing that the relationships are very similar to one another and the spreads are fairly stable. But if we graph the spreads, as are shown in Graph 5, you can see the variation over the past two years that has occurred in the yield spread between the strip and the cheapest-to-deliver cash bond.

What you would want to do if you were analyzing the trade would be to say to yourself "I want to be long on the futures which track against the cheapest-to-deliver bond when that cheapest-to-deliver is relatively cheap to the strip." That is, you would tend to like this trade when the spread was relatively wide, and the trade would have an awful lot of yield spread risk for you if that spread was relatively narrow. I mentioned that you can use options to help to deal with some of the convexity problems, but there is really no immediate solution that I can see other than good market timing and a good sense of price spreads in your market to deal with the yield spread risk. You simply as an aware investor have to be very cognizant of how the cheapest-to-deliver bond, which is what the futures is tracking, is priced relative to the stripped security; so you have to be a student of the spreads. What that means is that market timing or the spread analysis types of decision must be done in order to analyze the additional source of risk in the security.

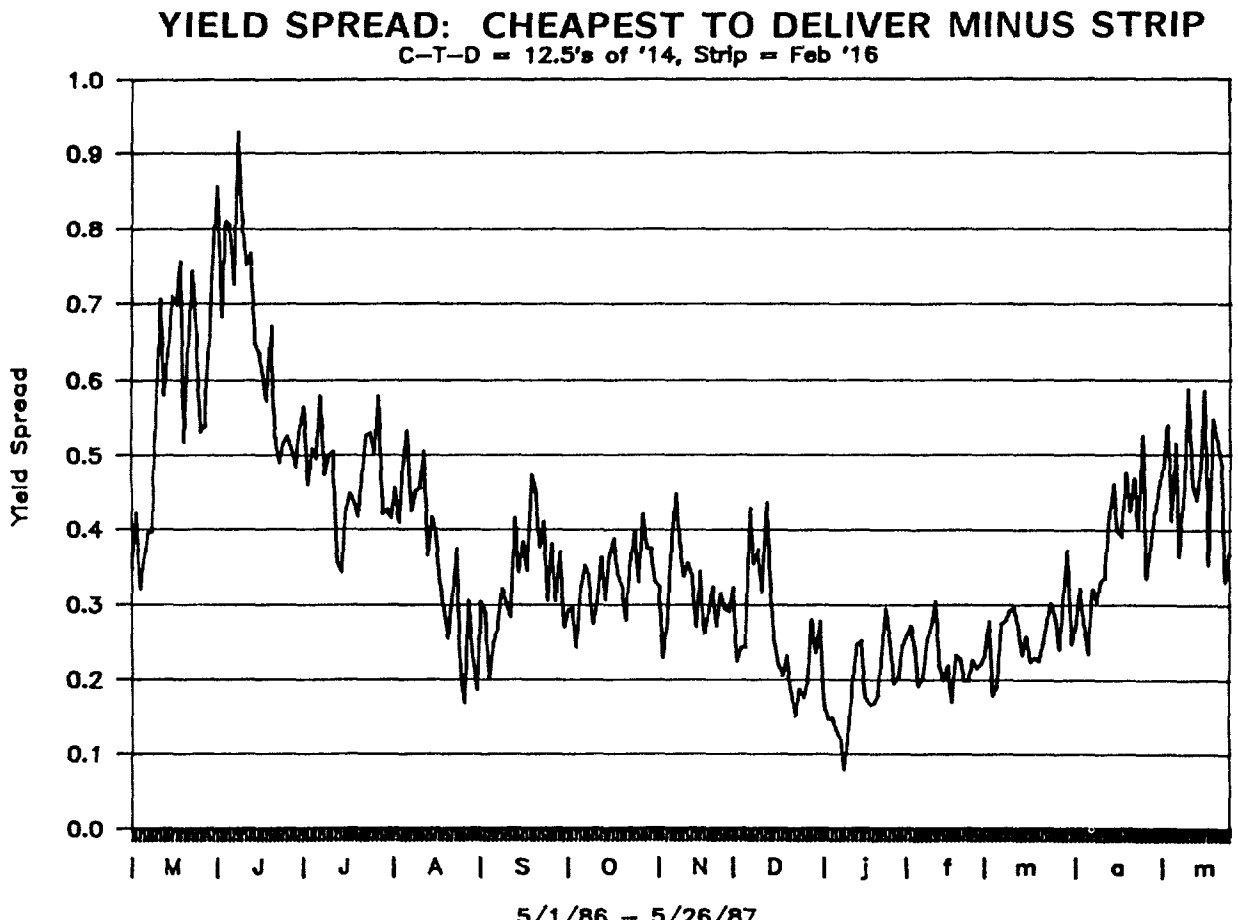
The next source of risk is basis risk. That is nothing more than an old commodity term for the spread between the cash and the futures price, in the case of Graph 6 the spread between the cheapest-to-deliver cash bond (the twelves of 07), and the December futures contract. That spread itself will move around based on quite a number of factors.

One of the ways I like to analyze the relative cheapness of the futures contract is to view it as being subject to cash futures arbitrage, by so-called "basis

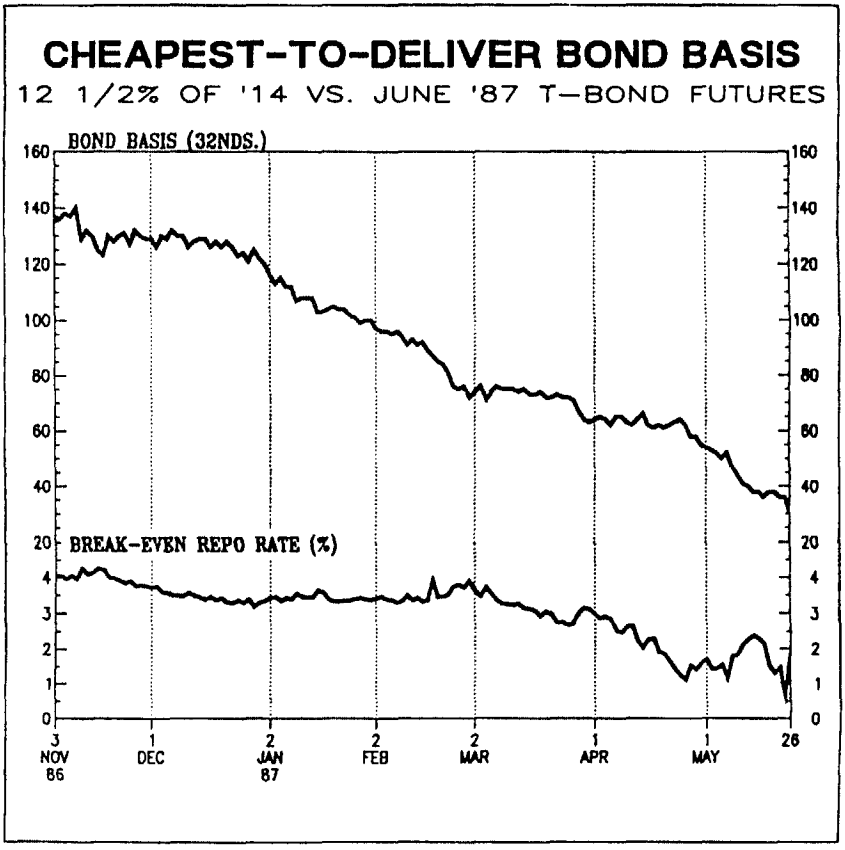
GRAPH 4


YIELDS: CHEAPEST TO DELIVER VS. STRIP
5/1/86 – 5/26/87
9.4
9.3
9.2
9.1
9.0
8.9
8.8
8.7
8.6
8.5
8.4
8.3
8.2
8.1
8.0
7.9
7.8
7.7
7.6
7.5
7.4
M
J
J
A
S
O
N
D
j
f
m
a
m
12.5% of 8/14
2/16 STRIP

GRAPH 5


YIELD SPREAD: CHEAPEST TO DELIVER MINUS STRIP
C–T–D = 12.5's of '14, Strip = Feb '16
Yield Spread
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
M
J
J
A
S
O
N
D
j
f
m
a
m
5/1/86 – 5/26/87

GRAPH 6


CHEAPEST-TO-DELIVER BOND BASIS
12 1/2% OF '14 VS. JUNE '87 T-BOND FUTURES
BOND BASIS (32NDS.)
BREAK-EVEN REPO RATE (%)
160
140
120
100
80
60
40
20
4
3
2
1
0
3 NOV 86
1 DEC
2 JAN 87
2 FEB
2 MAR
1 APR
1 MAY
26

traders" who essentially look at the profitability of the following trade. You could always buy the cash security, simultaneously sell the futures contract, finance the cash security until delivery, and then deliver into the futures contract. That kind of arbitrage is, in effect, creating a synthetic short-term money market instrument -- you're long on cash security, you've sold it forward, and you're financing it. The return on that investment can be compared to a money-market return, and depending on the magnitude of that return we have a criteria for measuring the relative cheapness of the futures contract. The reverse trade to that arbitrage, the so-called "reverse cash and carry" would be to create a synthetic long security composed of, let's say, the six-month bill, and a long December futures contract, and compare that to the price of the twelves. Indeed, arbitragers are constantly trading those two relationships in the cash government securities market. You as investors have to be aware of those relationships, and that whenever you consider purchasing or selling the futures contracts they will be affected by these arbitrage considerations of relative cheapness. My point here is that the analysis for determining relative cheapness is very well developed, and very much available to you.

Let me sum up briefly what I've tried to do here and what I've tried to operationalize. First, I've defined the notion of yield enhancement. A security enhances the yield in the portfolio if it has a better performance, a higher yield at the same risk. A definition of risk for this purpose is the duration of that security at a particular yield, and two securities at least at the first order of approximation, are assumed to be equally risky if they have the same duration. Next, I looked at the possibility of replacing the lower yielding with the higher yielding one. Then I began to point out caveats to the trade. The question you should ask yourself is, "Is the approximate 1200-basis-point apparent pick-up in the standstill situation worth the additional risks that were discussed in the second part of my talk, specifically the convexity risks, the yield spread risks, and the basis risks?" Finally, I pointed out that there are techniques for analyzing and dealing with each of those risks; convexity risk can be handled with options, yield spread risk can be handled by being an astute student of spread relationships and market timing, and basis risks can be handled by understanding what determines the relative cheapness of the futures contract at any point in time.

I think that when you consider any kind of synthetic securities the essence is to analyze them thoroughly. What do they cost you in terms of risk? You must also consider what the hidden risks of investing in these securities are in terms of convexity, yield spread, and basis risks.

MR. ROBERT P. CLANCY: It will probably seem strange to you that I'm speaking on the subject of mortgage-backed securities. After all, the session's topic is new investments and new investment strategies, and mortgages have been around for a long time. Well, I really believe that mortgage-backed securities are very relevant in our current, fast changing world. Mortgages serve as appropriate investments for both old insurance products as well as some of the newer ones. They've also spawned some new derivative products. Some of these derivative products include stripping out the interest payments from mortgages into an interest only piece, and stripping out the principle payments into a principle only piece. Other new derivative products that are spawned from mortgages include collateralized mortgage obligations (CMOs). Finally mortgage-backed securities have given rise to new analysis techniques that should be of interest to actuaries as well as investors. It's these analysis techniques upon which I would like to now focus.

The newly evolved analysis techniques for dealing with mortgages serve a couple of useful purposes. First, they are a welcome tool of analysis when everybody suddenly realizes that the old techniques don't work anymore. Second, these techniques are adaptable in a broad sense to the problems of general asset/liability management in an insurance company, which I'll try to show a little later.

Before I get to these analysis techniques I'd like to clarify just a few basic points. The mortgage-backed securities about which I'm talking consist of pools of residential mortgages, much like the mortgages you may own on your own homes. These mortgage pools generally combine mortgages with very similar characteristics, such as the length of borrowing or the interest rates. The borrowers' monthly payments of principle and interest are passed through to the owners of the mortgage-backed securities. The Government National Mortgage Association (GNMA) is perhaps the best known issuer of mortgage-backed securities, and they guarantee payment in the event of default by the borrower.

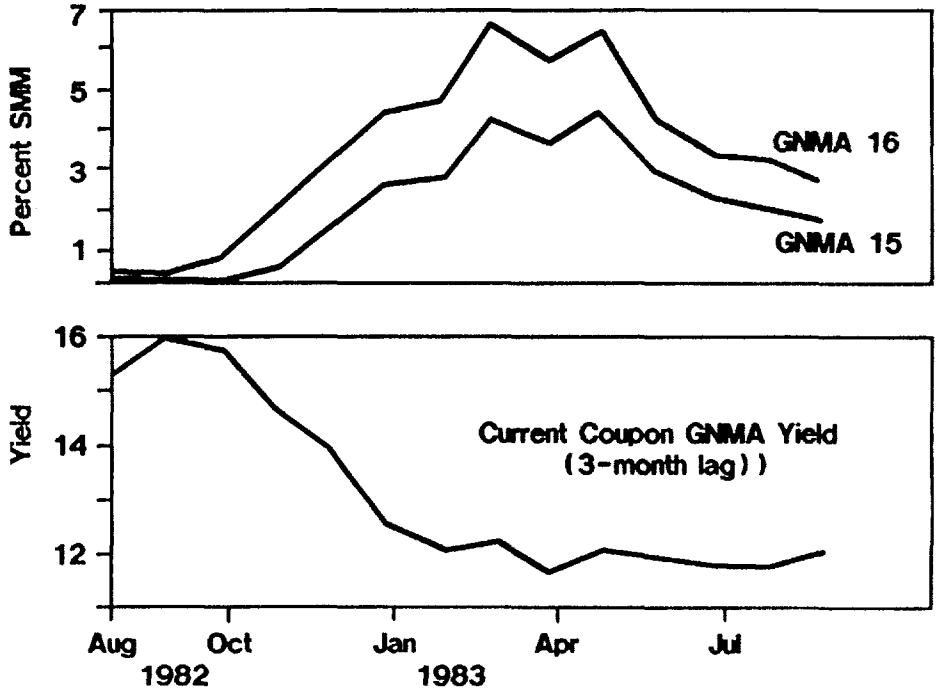
When we look at the individual mortgages underlying these pools, we realize that the homeowner has some flexibility which could affect the payments received by the owners of the mortgage-backed securities. If interest rates drop sufficiently, the homeowner can refinance at a lower rate. This results in a large amount of principal repayments being passed through to the investors in mortgage-backed securities at a time when interest rates are very low. This is not a scenario that's likely to please your basic investor. When interest rates rise, on the other hand, the reverse is true, and homeowners will be less likely to prepay their loans and they may be less likely to move. This slowdown of prepayments results in investors receiving smaller payments from their investments at times when interest rates are very high. Again, this isn't likely to please your basic investor.

The final thing that you should probably understand about homeowners' prepayment behavior is that some level of prepayments will occur regardless of interest rate levels. People will change jobs, relocate, and experience foreclosure. Graph 7 shows some historical prepayment numbers for some higher coupon GNMAs during 1982 and 1983 which tend to bear out my preceding comments. The top graph shows prepayment rates on GNMA 15% and 16% coupons (SMM on the vertical axis stands for single monthly mortality and is simply a representation of a monthly prepayment rate). The bottom graph shows the yield on current coupon, or new issue GNMAs and generally reflects the interest rate declines during the period around 1983. As interest rates dropped and bottomed out, the prepayment rates on the GNMAs increased drastically to a peak, and then eventually dropped back to a lower level.

Now those of you who are well versed in financial theory will realize that the mortgage borrower's prepayment flexibility here is akin to having granted him a call option. If all borrowers exercised their prepayment options in a rational economic fashion, then the valuation and analysis of mortgage-backed securities would be much easier. One could use some state-of-the-art option models and try to get a handle on the value of this security. But not all people do exercise their prepayment options in a purely rational and economic fashion, as evidenced by the fact that there still are some 15% and 16% mortgages out there. This inefficient exercise of the option makes the problem much more difficult to analyze. But it is absolutely critical to do so, because, as we will see in a few

GRAPH 7

PREPAYMENT RATES ON HIGHER COUPON GNMAs



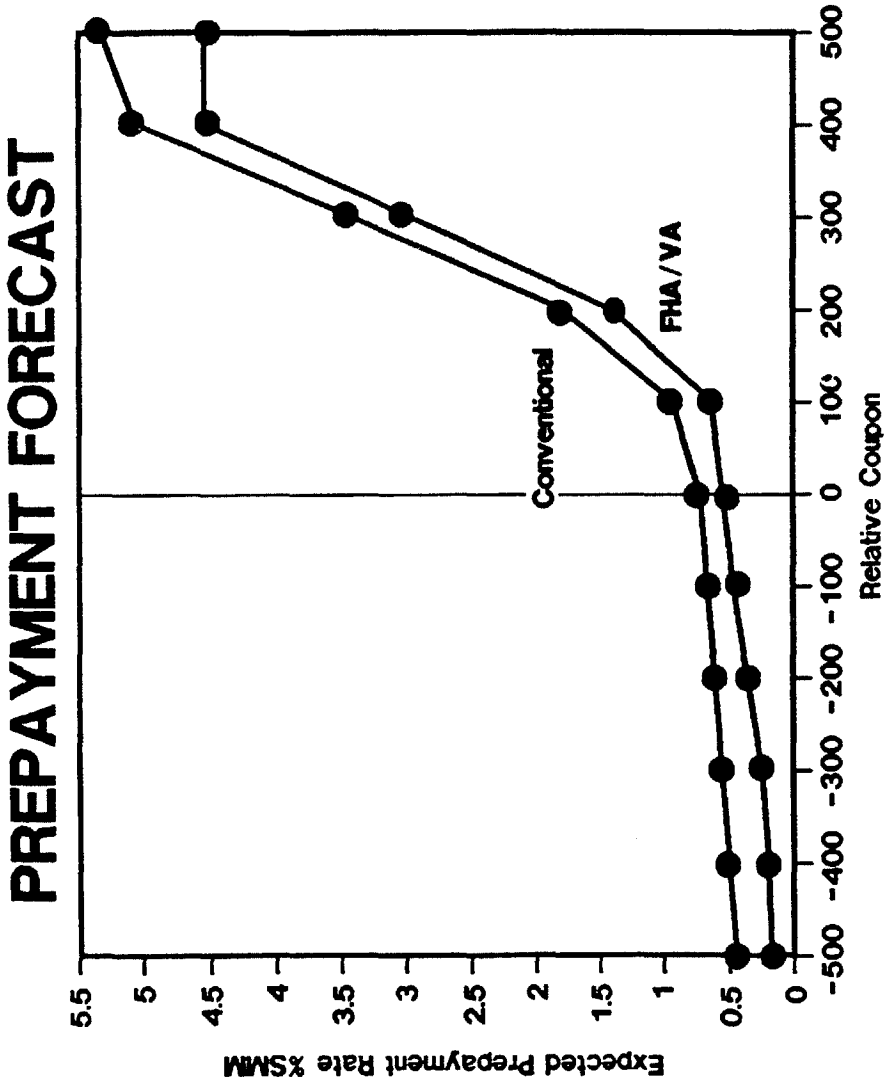
minutes, the mortgage-backed investors' returns are greatly influenced by the prepayment experience of the underlying mortgages.

The critical part of any analysis of mortgage-backed securities is the estimation of how prepayment rates change as a function of interest rates. Different approaches will introduce different levels of sophistication into the estimation process. One could take account of the age or seasoning of the mortgage-backed-securities, the pattern of interest rate changes, and so on. In the examples discussed here I'm using a prepayment assumption such as that shown in Graph 8. Here, the vertical axis represents projected prepayments measured on a monthly basis, while the horizontal axis represents the difference in basis points between the coupon of the mortgage being analyzed and the current coupon, or new issue, mortgage. For example, if current production GNMA coupons are 9 1/2%, and we're interested in analyzing an 11% coupon GNMA, then we'd be talking about a positive 150-basis-point differential. Thus, as we move to the right on this graph, interest rates are declining, and you'll see that our projected prepayment rates increased drastically as interest rates dropped and then leveled off. This graph shows a slight distinction in assumptions between mortgages that are FHA/VA insured versus conventional mortgages, but that's a small difference that I needn't go into here.

Once the prepayment assumptions have been set we can proceed with the rest of the analysis. The next step is to generate some interest rate scenarios to some time horizon. The final step is to compute the total return of the mortgage-backed security for each of these scenarios.

The scenarios could be generated stochastically, but that will most likely result in an abundance of results that may be hard to assimilate. It is probably best and easiest to use some simple, deterministic scenarios. The ones that I'm using here involve immediate parallel shifts of the yield curve. Now for each scenario the total return is calculated as follows. First, accumulate the assumed monthly principle and interest payments to the investment horizon at the assumed reinvestment rate for the scenario. Next, calculate the market value of the mortgage-backed securities at the horizon date. This calculation is not trivial and it involves both a discount rate and an assumed set of cash flows. The assumed cash flows are derived from the assumed prepayment rate based on

GRAPH 8


PREPAYMENT FORECAST
Expected Prepayment Rate %SMM
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-500
-400
-300
-200
-100
0
100
200
300
400
500
Relative Coupon
Conventional
FHA/VA

rates at the horizon. The discount rate consists of an appropriate treasury rate plus an additional increment called the spread.

In the example, in Table 3 the GNMA 8.5% coupon was the current coupon at the time these numbers were compiled. The estimated yield assuming no changes in interest rates was 8.59%, which was a 125-basis-point spread over seven-year Treasuries. It was further assumed that if interest rates rise 200 basis points the appropriate spread would be 105 basis points over seven-year Treasuries, and if interest rates drop 200 basis points the appropriate spread would be 115 basis points over five-year Treasuries. The use of five-year Treasuries as a reference point when interest rates drop reflects the fact that when interest rates drop the mortgage-backed securities' prepayments should increase, resulting in a shorter investment.

At any rate, the net result of these kinds of assumptions relating to the appropriate discount rate is shown in Table 3 under the column "Horizon Yield." Thus, if interest rates drop 200 basis points the yield on an 8.5% GNMA is assumed a drop from 8.59% to 6.24%, and if interest rates rise 200 basis points the yield is assumed to increase to 10.39%. Table 3 also shows the assumed projected prepayment rate under each of these interest rate scenarios. Combining those two columns we're able to calculate a price at the horizon date in the next column. Finally taking this price at the horizon date and combining that with the assumed reinvestment of interest and principle payments to the horizon, we're able to calculate a total return for each scenario as shown in the right hand column.

These results can also be graphed, which are shown in Graph 9. Notice that this graph has somewhat of a concave downward shape to it. This is a graphical depiction of another buzzword, namely "negative convexity," that you've probably all heard. From an empirical analysis such as this, it is possible to estimate both duration and convexity.

As Gary mentioned earlier, one should realize that an increase in interest rate volatility will greatly increase the value of the call options that have been granted to the borrower. So an increase in volatility should negatively impact the value of a mortgage-backed security since you've granted a call option through the purchase of this animal. Those of you who aren't familiar with

TABLE 3

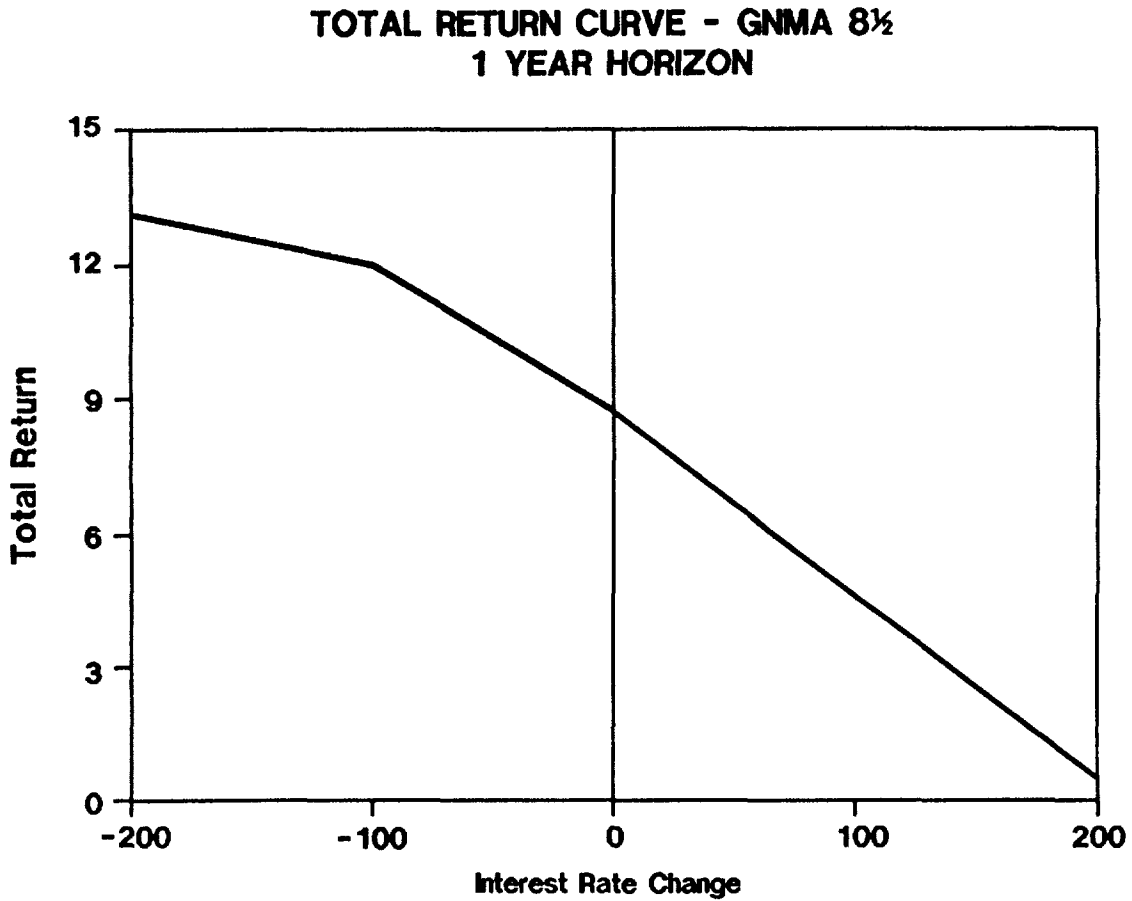
SCENARIO ANALYSIS

GNMA 8½%
Price = 100-00
Yield = 8.59%
Age = 9.20 Years

ONE-YEAR HORIZON
REINVESTMENT RATE = 6%

Interest Rate Scenario	Horizon Yield	Projected Prepayment	Horizon Price	Return
-200 bp	6.24%	2.20% SMM	106-12	13.04%
-100	7.74	.85	103-26	11.87
0	8.59	.60	100-00	8.56
+100	9.49	.50	93-15	4.41
+200	10.39	.45	91-02	0.32

GRAPH 9


TOTAL RETURN CURVE - GNMA 8½
1 YEAR HORIZON
Total Return
15
12
9
6
3
0
-200
-100
0
100
200
Interest Rate Change

option pricing and are maybe a little skeptical about this whole thing will hopefully appreciate this point shortly.

Consider a lognormal distribution of interest rates. I could make the same point using a normal assumption of interest rates as well, but I have chosen a lognormal one. Table 4 shows that we can construct a discrete distribution of interest rate changes which approximates the assumed lognormal distribution. This table shows assumed probabilities of interest rate changes at volatility levels of 8%, 12%, and 16%. Note that the probabilities of the more extreme interest rate changes, like up and down 200 basis points, increases as the volatility level increases.

We can now combine the information from the previous charts and compute some expected returns for each volatility level, which are shown in Table 5. Note that the expected return decreases as volatility increases. At an assumed volatility level of 8%, the expected return is 8.33%, and at a 16% volatility level the expected return is 8.10%. The same effect can also be seen graphically as shown in Graph 10. Now if you're observant you may have noticed that I have cheated a little here; the top graph is of a GNMA 10% coupon rather than the 8.5% that I was talking about earlier. I'm not really cheating, I was just borrowing graphs from perhaps too many different people. However, the point is the same regardless of which graph I am actually showing. So in the top graph we have GNMA 10% security for a 10-year Treasury against interest rate changes in basis points. The bottom graph shows the probability distributions of interest rate changes for 10% and 18% volatility. Now if there is very low volatility then there is very little likelihood of extreme interest rate changes, and in particular extreme interest rate drops. It is when interest rates decline significantly that you suffer severe underperformance on a mortgage-backed security. Conversely, if volatility is higher then extreme interest rate drops are more likely. Thus, the higher the volatility, the greater the probability of the mortgage-backed securities' negative convexity coming back to hurt you. So it makes sense that the value of the mortgage-backed securities should decline as interest rate volatility increases, reflecting the value of the inherent prepayment option.

So, summarizing the discussion so far, the current methodology for analyzing mortgage-backed securities involves scenario analysis. Scenario analysis is

TABLE 4

SCENARIO PROBABILITIES - LOGNORMAL

1-Year Holding Period

Interest Rate Change	Volatility Level 8%	12%	16%
+200	0.71	4.75	9.85
+100	18.34	22.07	21.02
0	63.20	45.24	34.86
-100	17.63	25.62	27.10
-200	0.12	2.32	7.17

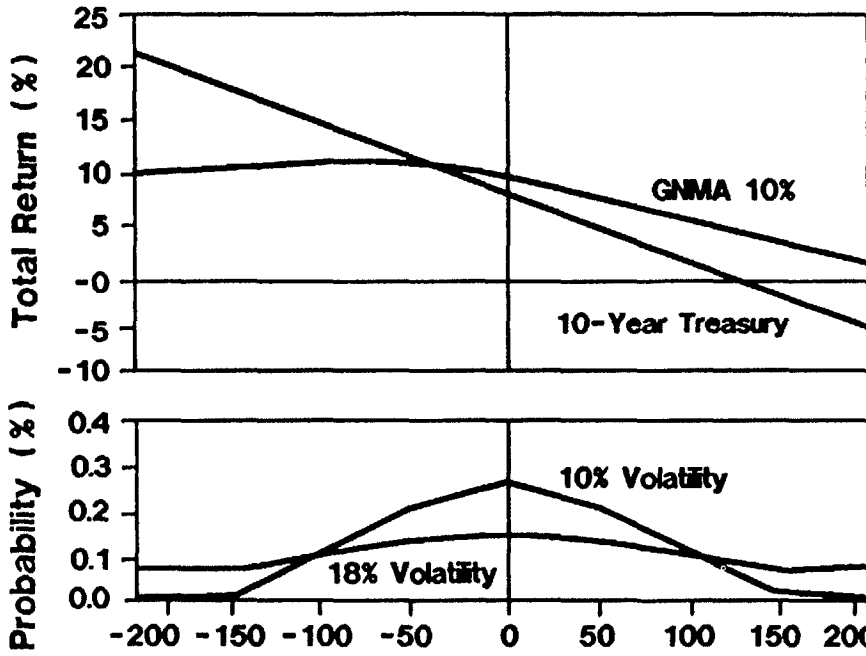
TABLE 5

SCENARIO ANALYSIS
EXPECTED RETURN

Interest Rate Scenario	Return	Lognormal Probability Distribution Volatility Level 8%	12%	16%
-200 bp	13.04%	0.12%	2.32%	7.17%
-100	11.87	17.63	25.62	27.10
0	8.56	63.20	45.24	34.86
+100	4.41	18.34	22.07	21.02
+200	0.32	0.71	4.75	9.85
Weighted Average Expected Return		8.33%	8.21%	8.10%

GRAPH 10

TOTAL RETURN CONVEXITY



necessary because the homeowners' prepayment options result in cash flows which depend on interest rates, and on the path of interest rates. Furthermore, the inefficient exercise of these options by the homeowners precludes the use of standard option pricing models. Calculating an expected return over several scenarios captures the effect of the inherent option.

The final question I would like to address is what any of this has to do with insurance company asset/liability management. Well, if I had described the scenarios in my example as plausible or reasonable, you might have thought that sounded familiar. In fact, the approach is very similar to the scenario approach used for C-3 risk analysis of interest-sensitive products by valuation actuaries. If you substitute the words *surrenders* or *lapses* for *mortgage prepayments*, the analogy becomes even more obvious. The problems of analyzing the interest rate risk of interest-sensitive products are really the same as those encountered in analyzing the risk of mortgages. As Gary mentioned earlier, the policyholder has options granted to him through the surrender, policy loan, or premium payment provisions of the contract. These options affect the cash flows under the policy, and their use is a function of interest rates. Furthermore, policyholders do not exercise their options in a completely efficient manner, so standard option pricing models can't be used to evaluate the risk.

Now, I concede that the analysis of interest-sensitive products is probably more difficult than it is for mortgage-backed securities. The approach outlined here for mortgages typically uses horizon periods of six months to one year. The modeling of interest-sensitive insurance products on the other hand usually extends well beyond one year, thus introducing more complexities into the number and types of scenarios examined. Nonetheless, I still think that actuaries can learn a lot from studying this research on mortgage-backed securities that's been put together by some of Wall Street's best minds. At the very least, the C-3 Risk Committee can feel vindicated by the scenario approach adopted for mortgage-backed securities.

Now, since mortgage-backed securities have such similarities to interest-sensitive products, you might think at first that mortgages would make an appropriate investment strategy. Well, it isn't necessarily so. The degree to which mortgages would make appropriate or inappropriate investments depends on such things as product design and the liability management strategy. Generally

however, the options granted to mortgage borrowers do not offset the options granted to policyholders. In fact, the options granted on the assets and liabilities may be very similar, effectively resulting in a "double or nothing" bet on the direction and volatility of interest rates. Scenario analysis should help you to better understand the nature of these bets, or risks. Once you better understand the option-like risks of the assets and the liabilities, you can investigate some judicious uses of new vehicles such as options, futures, zero-coupon bonds, CMOs, interest rate swaps, and strips of mortgage securities like IOs and POs to help counteract the negative effect of these granted options. Even if you then decide not to adopt such an investment strategy, at least you've got a better appreciation of the risks of not matching. In short, depending on your tolerance for risk, mortgage-backed securities may be appropriate investments for interest-sensitive products, but they may need to be combined with some other carefully selected investments.

So wrapping up, I think that sound mortgage-backed securities analysis is a necessary part of today's investment function. This analysis is also critical for those trying to understand the new mortgage-based derivative products, such as mortgage strips and CMOs. And I think today's actuaries might benefit from studying some mortgage-backed securities analyses. After all, these analyses address very similar problems to those faced by pricing and valuation actuaries dealing with interest-sensitive products. We must face the fact that the days are gone when actuaries could blithely assume a single, stable, long-term investment assumption, such as Gary described in one of his first actuarial assignments. So look over some of this research. It may provide some food for thought for modeling interest-sensitive products. It may suggest some better investment hedging techniques for such products, and it may even be as useful as some of the more traditional actuarial journals.

MR. MARK MAISONNEUVE*: The use of a synthetic security relies heavily on the duration concept. In testing different scenarios, this concept, in turn, assumes parallel shifts in the yield curve. In reality, however, volatile interest rate environments never have parallel yield curve shifts. Aren't you then asking for trouble in presuming that the synthetic security is going to act like the bond that you replaced?

* Mr. Maisonneuve, not a member of the Society, is with Maccabees Mutual Life Insurance Company in Southfield, Michigan.

MR. RICHARDS: I think duration, as I tried to indicate, is the starting point in risk analysis. It's certainly not the ending point, and in effect when I talked about yield spread risk you could have called it yield curve risk (changes in yield curve). Now the question that I think you have to ask yourself again over a six-month holding period is whether or not the 1200-basis-point pick-up in this case was worth accepting some of that risk, but you are absolutely correct.

MR. SIBIGTROTH: Bob, you had a similar assumption for some of your scenario simulations. Can you quantify what the effect is of a rotation in the yield curve, and how that might be analyzed?

MR. CLANCY: I guess I'll answer it in two parts. First of all, just with respect to mortgage-backed securities, I don't think it's quite so critical there. As I'd mentioned, we are dealing with shorter time frames, and the net result of that is that what's happening on the short end of the yield curve is really affecting just what you're earning on your interest and principle payments over this relatively short period. The effects of that are totally swamped by the price effect that happens with changes in the longer term interest rates that are affecting the price of the mortgage that you are assuming on the horizon date when you sell it. So I don't think these rotations in the yield curve have quite as much impact on the analysis of mortgage-backed securities, but I think that they do when you're dealing with the modeling of interest-sensitive products. As I said, there you're going out for longer time periods. Also, some policyholders may be more influenced, as far as surrendering policies or taking policy loans, by what's happening on the short end of the yield curve rather than what's going on at the long end. So there again it boils down to, as John was saying, if you are going to do a good job you should probably be pretty careful in your sensitivity analysis and look at some nonparallel shifts in the yield curve and see what the results are.

MR. EDWARD L. ASTRACHAN: Since United States money is a fiat currency, its value derives from laws requiring its acceptance and scarcity determined by the Federal Reserve System, operating in a political and economic context. To what extent can we ignore economics and politics and deal with the mathematics which assumes a certain degree of stability of the properties underlying the

movement and volatility of interest rates? Can we really insulate ourselves from the larger political and economic context?

MR. YAWITZ: The approach that I'd like to take, which maybe reflects my ignorance, or comfort, or both, is synthetic security analysis looking at what you might call value added swapping opportunities in one position and out of another. That is really assumption-free, where you are comparing likes with likes. So if there is a way that I can replicate a particular credit, let's say on a five-year bullet, and I can replicate that five-year bullet with different raw materials, the bottom line end result is that I still end up with a five-year noncallable security issued by borrower XYZ. It seems to me that these loftier issues that you brought up a second ago are important because people in your business own a lot of assets with various default characteristics. But when you take a more simpleminded view of it as I do, where we are comparing apples with apples, as the economists say, as opposed to apples with oranges, I think we can circumvent at least some of those problems. If you start talking about plays in the market that differ drastically in terms of these buzzwords of convexity, positive/negative convexity, buying or selling volatility into the market, then there is no question that if you were to tell me what was going to hit the fan over the next couple of months it would make all of this synthetic security analysis irrelevant. But, what about x being able to forecast the future and forecast what's going to happen to credit spreads and volatility spreads? I think we are probably back to doing this type of analysis more than what is probably the more global approach of putting the fundamental economic variables into the analysis.

MR. WENDLANDT: I think that it's also important to recognize that the majority of the liabilities that we're talking about here are nominal liabilities rather than real liabilities, and the macroeconomic issues that you raise, being as they are associated with inflation, would to a much greater extent affect somebody with a real focus rather than a nominal focus.

MR. RICHARDS: It seems to me that your question really addresses a fundamental question which the social sciences have to face. All of our statistical and analytical tools, where we derived our option pricing models, assume a statistically invariant underlying structure, which is generating the impulses that we measure statistically. Fundamentally those processes are time invariant. It's not

at all clear that social processes are time invariant; that is that they are being generated by the same underlying structure, and there can be enormous jump shifts in social structure. When one analyzes any set of social data or economic data one of the fundamental issues is to what extent are these data being generated by an underlying stable structure, or a statistically unstable structure. We tend to assume that the structure is stable and at times gets into great trouble that way.

DR. V. MICHAEL SHANTE: I have a brief comment and then a question for either Bob Clancy or Jess Yawitz. The comment is regarding our discussion of structured transactions wherein securitization of policyholder loans was also mentioned. We at Prudential-Bache are still working on a structured transaction involving policyholder loans. The transaction has not yet been completed and we are not in a position to elaborate on it. However, the basic idea is similar to that of a CMO given the collateral, which could be a mortgage, or in this case policyholder loans. We structure the associated cash flows into different trenches and try to add value to the whole deal.

My question is regarding mortgages and callable bonds which have option-like features imbedded in them. The discussions indicated that these instruments are being analyzed, priced, and their durations and convexities calculated under different plausible or reasonable interest rate scenarios. Would it be more appropriate to look at interest rate paths which are free of arbitrage possibilities and do the analyses in an option-pricing framework, with either a binomial lattice or a differential equation approach, and determine a unique price, a unique duration, and a unique convexity?

MR. YAWITZ: The question is to contrast scenario analysis with actually using an option pricing model to value the option imbedded in the security?

DR. SHANTE: Yes.

MR. YAWITZ: Let me just talk about the part of this side of the business in which I get involved. We have several clients with whom we work valuing either on an individual bond-by-bond basis or on a portfolio of bonds, going through the following experiment. If you, on the buy side, own a callable bond, say a ten-year noncallable five, and we would agree on what the fair five-year

noncallable bullet rate would be and the fair ten-year noncallable rate for that issuer, we can compute, very simply, the value of the call option, or what you are getting paid for writing the option to the issuer. The only other step in the analysis is that if I value the ten-year callable security's coupon and principle payment at the appropriate ten-year noncallable rate then I would calculate a dollar price higher than the value of the callable bond in the market. This difference is the market's value of the call option. The only other step is to now ask, What implied volatility would result in that option price also being the fair option price? And since the buy side, for a reason that escapes me, tends to like writing options as opposed to buying options, from your perspective you want the highest possible volatility in terms of the answer that would be provided. In terms of motivating swaps from the buy side getting out of a bond or a portfolio of callable bonds into another bond or portfolio of bonds, where the option volatility that is imbedded in those bonds is higher, a pick-up in yield or pick-up in value will not have increased any exposure in terms of the net position in writing volatility in the market. The scenario analysis is nice in some ways to augment the approach that I just went through and maybe even to make the buy side more comfortable to dimension the risks in terms of what the various outcomes might be in the different rate environments. But it is an underlying model that would be used to say at what volatility level you are being paid.

I've mentioned a couple of times that the fact that there is such a proliferation of investors writing options back to issuers, as opposed to the other way around, is something that may be worth thinking about. Why, for example, are there so many more callable bonds in the market than put bonds, where the investor owns the option? Many of the issuers with whom I speak say they'd issue put bonds except that the investment community isn't willing to pay for the option. So maybe it's fascination on the buy side with current yield that leads to this interest in writing options and getting a "higher stated yield" than perhaps the expected rate of return. Whereas if you buy an option, as in a put bond, you would take a lower coupon on the security than the expected return because you are the owner of an option that has some value also.

MR. CLANCY: I don't think that what you were proposing was inconsistent with the framework about which I was talking. I could construct a fairly complicated binomial lattice of yield curves and select some scenarios from that, apply

probability weights to it, and choose to define those as plausible and reasonable scenarios using my own definitions of plausible and reasonable. So I don't think that there is anything necessarily inconsistent with the approach about which I was talking, and the more complicated binomial lattice or option-based approach to the problem. What you have got to ultimately analyze is whether you are really picking up additional information from the more complicated approach, or whether you are losing sight of some of the basic mechanics that are going on to help you understand why it is that the security or liability is behaving the way that it is. Whether it's prepayment rates, or surrender rates, or something else, it all comes back to that you've got to be able to understand the model with which you are dealing.

MR. DAVID A. HALL: Much has been written lately on the use of mortgage securities and their derivatives to create synthetic securities with certain duration properties at an enhanced yield. Assuming that there is no free lunch, and that sometimes these work and sometimes they don't, could you comment in actual practice as to what goes wrong, and share perhaps any horror stories that you may have encountered? I'm interested in hearing about the down side here.

MR. CLANCY: I don't think I've got any war stories to share with you right now on using the derivative products to create new synthetics or to hedge out other kinds of risks. Certainly there have been stories published recently that highlight the risk of some of the derivative products. You do need to be aware of the critical factors that enter into analyzing these derivative products. When I was talking about modeling the mortgage-backed securities, one of the things that I mentioned was a spread. Spread changes can really kill you, and you've got to be careful and aware of that. If you are in the investment for longer periods of time, and you've looked at it, you may conclude that these spread changes are fairly cyclical, and you may be willing to ride out some of those cycles.

MR. YAWITZ: If you were to look at when the investment banking community presents ideas, invariably it turns out that our collective fascination with a yield number, with all of the problems inherent in its calculation, leads us to generally view in a more positive light a synthetic position or a cash position where the owner of the security is a writer of an option, because the yield number is

higher than when the owner of the security is the buyer of an option. And it's exactly in those environments, or in those securities, where one is the writer of an option, where only the quality of the interest rate scenarios at which he is looking are relevant in determining the actual return performance. What I'm trying to say is that we are not very good at dimensioning risk or getting everybody comfortable with risk, and as a result, not surprisingly, higher yielding instruments invariably, whether it's credit or synthetics, tend to also have higher expected returns. Now I don't know if they really do, or whether we're just making mistakes when we try to dimension what the risks are in high yield, i.e. high-risk positions.