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SESSION 11: FINANCIAL ENGINEERING -- WHAT IS IT AND HOW IS IT RELEVANT TO THE ACTUARIAL PROFESSION?

PANEL

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DAVID F. BABBEL
JEREMY GOLD
RICHARD Q. WENDT

2000 CCA ANNUAL MEETING

MS. JANICE P. BRICKER: How many people know anything about financial engineering? Can I get a show of hands from the audience? Just a couple. So many people are here to learn. Yes, that's good. We hope to have a fairly interactive session. Our panelists are Jeremy Gold of Jeremy Gold Pensions, and we have Dick Wendt of Towers Perrin, and we have David Babbel of the University of Pennsylvania. Prof. Babbel is going to start off with a high-level overview. Next will be Mr. Wendt talking about financial engineering and global markets. And Mr. Gold will address some challenges for the pension actuary.

And a little bit of a commentary on the session description. Although there is competition for talent between the two professions, financial engineering and the actuarial profession, that's not necessarily the challenge that Mr. Gold will address, and I'll let you...I won't let you in on what that is. You'll have to wait for it.

Please be sure to bring your tickets up. I'll remind you at the end of the session. And for question and answers, I'm going to try to circulate throughout the room with a lavaliere microphone and hope that we will be able to get most everything on tape.

PROF. DAVID F. BABBEL: It is with mixed emotions that I address this group. I'm not an actuary. I'm probably the only one here who isn't. You can see my name is Professor Babbel, which is regarded as a redundant term by some people. It is with mixed emotions that I face this group, and I came across an interesting definition of "mixed emotions." It is the feeling you get in your heart when your 16-year-old daughter comes home from a date at 6:00 in the morning with a Gideon Bible firmly tucked under her arm. Or in this hotel, I guess it would be a Book of Mormon, actually. Anyway, the mixed emotions come from...I got one of these bags for coming to this conference, and on the one hand, my friends might think I've become an actuary, on the other side I can now charge my clients more money.

Well, one way to start out is with some definitions, and before I talk about financial engineering, we have to discuss what structured products are. Structured financial products are financial instruments that are designed, created, bundled, issued, and sold to investors to meet specific investment objectives, and financial engineering is the process of creating or structuring financial products by bundling together fundamental securities forwards and options. These payments are linked to one or more assets, such as U.S. and international stock prices, interest rates, currency exchange rates, commodity prices, and other sort of indices.

Now there's also going to be a mixed-emotions part to this talk, not just to my being here to present it, and that is

because I was asked to teach the first financial engineering or structured financial products class at the Wharton School in the executive M.B.A. program. And we gave that for the first time last spring. As I learned more about it, so I could teach a class on it, I started getting really enthusiast, but then, as you learn still more, you find that there's a rather steep downside to this whole area of financial engineering, so the last slide I want to talk about is the downside.

There's an interesting book out on financial engineering by Smith & Smithson, and they claim that all financial engineering basically takes the building blocks, three building blocks, and you can create also any security out there. One is a fundamental security such as a stock or a bond, another is a forward contract, and another is an option. An example, for instance, of an interest rate swap is when, you can replicate the payment pattern of an interest rate swap by simply taking a bundle of forward contracts on interest payments. For instance, futures. You simply can do a daily rollover of resetting forward contracts and creating interest rate futures contracts. And a structured note, you simply take a fundamental security, such as a bond, and couple it with an option, such as an option on the stock market.

I was attending a wedding a week ago up in New York, and everyone there seemed to be investment bankers except myself. And we were sitting around a table having dinner and talking about what I should say to this group about financial engineering, and basically the bottom line was that all that's being done in financial engineering is taking the things you're already familiar with and repackaging them in ways that might make more sense for your investment objectives. At the same time, there is a downside to it that they discussed, which we'll get to. So if you think of the analogy that was used by Smith & Smithson – that financial engineering is like taking a box of Legos – you all have these building block pieces, and by selecting appropriate boxes and assembling them in creative ways, a financial engineer can create structured securities that meet the particular needs of investors. And the financial engineer structures range from pretty to pretty ugly. The ugliest ones can be unloaded if their yield is high enough. And of course, you usually unload them to an insurance company. You have the residual tranche which is the stuff that is really out there and very difficult to price, but there's always someone who will take it if it has a high enough yield.

Why would you use structured financial products? Well, they can address the financial objectives with greater flexibility than the alternative securities offered by traditional exchanges such as traded stocks, bonds, futures, and options. They can enhance potential returns or protect against market downturns, and that second reason is the most important probably. For instance, if you were a pension fund, you could invest in bonds coupled with some linkage

to the stock market. If it goes up, you get that side as well. So you can get security turns based on the performance of broad-based benchmark indices or specific custom-made industry sectors, or even a particular stock. For instance, sometimes you'll see some chemical company issue stock or issue bonds with structured products that are linked, say to IBM security performance...a pharmaceutical company. You can engineer these things any way that you can imagine. I taught a whole seminar course on the different variations of this.

Another thing you can do with structured financial products is to defer, avoid, or reduce transactions costs, taxes, and management fees. Sometimes it becomes much cheaper to achieve your objectives through these sorts of products. The investors in these products include retail investors. You have to have appropriate experience in financial goals. Also sophisticated high-net-worth individuals can invest in these: fund managers, such as pension funds, mutual fund investment advisors, asset managers, hedge funds. Insurance companies invest in these a lot. Governments and government agencies do. In fact, you may remember Orange County, one of the biggest investors in structured products around.

I was talking with some people from Merrill Lynch. I said when they were trying to undo the portfolio of Orange County, all of it was AA or AAA-rated, just that you couldn't sell it. So I said, "Well, if you can't sell this stuff, why don't you just undo it?" And I gave them one security to undo. They said, "Well, to undo that, it would take 54 different transactions, hedges." You see, you take these Legos and you bundle them up into something, but then to undo them is very difficult, and it is even more difficult to sell the thing because you built it the way you wanted and someone else may want it built a different way, so you have to undo it and then redo it in a different way. Very difficult.

You have governments and government agencies, as I said, corporations, corporate executives, financial intermediaries, arbitrage funds, arbitrage accounts, investment and commercial banks.

Now the range of products goes to the speculative investor. They may seek short-term returns from warrants or exotic options that are many times greater than their initial investment, but which could also expire worthless. On the other hand, the conservative investor may consider a principal protected note. At maturity, the principal is returned plus any appreciation from price changes of the underlying asset, such as currency exchange rates, stock of an emerging economy. Here are some of the types of structured financial products. One of them has been around for 100 years, but it gets lumped into this category because that's exactly what it is, it's a warrant that you have on, say, a bond.

Index-linked notes, asset-linked notes. We're going to talk about index-linked notes in a minute a little bit more. Convertible securities. So all of those...well, number 1 and number 3 are very common. Number 2 is new. Equity-linked notes, also a new category. Exotic options and warrants, and some of these are so exotic they are almost unimaginable to people in the investment field, such as myself. They're just very new. Swaps, investment trusts, over-the-counter private replacements, monetization, and hedging strategies for restricted stock. So if you are a corporate director or officer you get a big stock issue, but you're under restriction for a year against selling it. *The Wall Street Journal* can put together a package for you that will hedge you against downside price movement.

The linkage forms. If you are getting one of the link notes, these link notes can be linked to the absolute price levels or index values. They can be linked to spreads between individual securities. For instance, you can get a BBB and a AAA yield, and the spread between those could widen or narrow. Well, you can get a structured product that will pay off if it narrows and another one that will pay off if it widens.

Baskets of particular securities that are of interest, sectors, indices, markets. The reason you might want to basket one is maybe you invest in a particular basket of securities, but you want a structured product that will hedge you against downside movement in the basket particular to your interest. You can also get these things linked with correlations between two or more asset classes, linked to the yield curve shape, convergence or divergence between the long and the short rate.

Index-linked and other asset-linked notes is the only area that I'm really going to get into now because we can't cover all the other categories. Some people call the index-link notes, "common stocks with training wheels." What they do is offer principal preservation. They return principal at maturity and then give you the upside in the stock market. The way they accomplish this is: Suppose you gave someone $100,000 for one of these index-linked notes. Now they are going to return to you five years later with the $100,000 plus all the appreciation. Well, what they do is take the $100,000 and buy a zero coupon bond...and this is one way to do it...for $60,000 and take that other $40,000 and synthesize an opinion on the market, and that's how they accomplish this. Why don't you just do it yourself? Well, some financial institutions are not allowed to do it. They are not allowed to invest in options or have restrictions, but they are allowed to invest in debt instruments. And so they package them together through a structured note, and it counts as a debt instrument. The offer of potential capital appreciation is based on some index or other asset, and typically there are no periodic coupon payments in these instruments. Interest is typically paid at maturity based upon the price movement of the underlying assets, such as oil prices, S&P 500, U.S. long bond yields, what have you.

Well, we don't need to cover this one. This is for the issuers of the notes. This is what they do with it. And now the final slide, investors beware. Some of you may remember when the federal government used to issue debt from their 35, 40, or 50 agencies...one time even over that...each of them issuing their own debt to fund their purposes. And it ended up that the debt all started getting very inefficient in terms of market interest because there were not enough parses of debt to attract big interest. So then the government consolidated all of the debt issuant to five or six agencies that do it for everybody, and now there's enough liquidity that it makes the market very rich and viable. Well, structured notes do the opposite. They take things that are ubiquitous, forwards futures, and fundamental securities, and they decouple them and repackage them into something that maybe nobody wants but you. And so there is no liquidity. There's a big $10 billion insurance company and another $20 billion insurance company that just went into insolvency because they had all these AA and AAA securities, but when they had a little liquidity crunch, they couldn't unload them fast enough to meet the demand. So that's the biggest problem of these notes. High quality, no liquidity. It's like buying real estate. How long is it going to take you to sell it?

The creditors can be a big concern, too. Not all of these have high credit risk. Usually you put a wrapper with someone with higher credit risk to guarantee, but then you have other layers of risk there. They are very profitable for Wall Street. That should say something to you right there. If they can take these things that are cheap and repackage them and sell them expensive, why are you doing it? Well, maybe because you can't buy them cheap because of some restrictions, but for pension funds you don't have those sorts of restrictions, at least to my knowledge. And esoteric packaging means difficulty in determining appropriate values. This is really an important point.

One of the companies that went bankrupt had...one of the big five accounting firms...and they marked-to-market all of the securities, but when they got to the structured notes they were all AA or AAA. The accounting firm is not going to know how to value these things. It takes a real rocket scientist to do it. And then when you actually...after you've valued it, when you try to sell it, what if you can't find someone to buy it at a theoretical price? And so these companies were blind-sided. They didn't know...the companies that went insolvent...they didn't know that these instruments could not be unloaded for what the accounting firm was saying. The accounting firm didn't know either. They couldn't even value it, so they just asked the originator.

Legal risk looms. All right. When you invest in anything different there is legal risk, right? It's like my friends in the government when I was suggesting inflation-indexed bonds to them in 1981, their attitude was, "Nothing should

ever be done for the first time." Finally, yields can be very deceiving. Yields will...they are good for marketing purposes, but there's a big difference between yield and expected return, and the more esoteric the structure, the bigger the divergence. So you can't be fooled by yields.

MR. RICHARD Q. WENDT: Thank you, Prof. Babbel. Let me get started. Now when Ms. Bricker asked how many people knew about financial engineering I noticed that a couple of people raised their hands and a couple more left the room, so I hope we didn't scare people away. So thank you all for staying.

I'm going to take a different slant on financial engineering as opposed to structured products, derivatives, or other complex financial calculations. I'm going to be talking about financial engineering in a modeling perspective. I basically work in the asset liability modeling area of Towers Perrin, and we work with some very complicated models worldwide for multinational corporations, and it really requires solving some very interesting and complex problems to get everything to work together...not only hedging, transactions, or financial projections on a combined basis, but asset liability modeling for many different kinds of plans.

What are some of the issues in a global environment? Currency is very obvious. That's one of the first things that comes to mind, but also inflation. As you look at the different countries around the world, how does inflation work? What does it mean? How is it coordinated with other countries? Yields are very complicated. We'll see later that for modeling yields in the U.K., for instance, versus U.S., the data may not be compatible. There may be other inconsistencies in trying to get everything managed together. How do asset returns work when you are talking about a multicountry environment? Especially if you include developing markets and the more mature economies in the same model, how do they all tie together?

Some relationships are fairly consistent and theoretically sound. Long-term relationships are of that nature. Some of the more short-term relationships are more uncertain. Everybody has a theory, but very few know the complete answer. Some of the models are the multinational companies that have subsidiaries in five, six, or seven different countries. One of the things that we are wrestling with is trying to do not only individual models in each country, modeling pension plans in that country as well as the economy of that country, but then converting all those results to a common currency and then having a total economic model for the multinational pension plan. That is in fact extremely challenging.

For our work these are some of the countries. We're going to have, for extra credit, a quiz at the end of the session to

identify all those flags. But we have worked pretty much...Australia to Finland on perhaps the two extremes of the countries there, but basically major countries and minor countries we've all looked at to get their characteristics and all the different relationships.

One of the complexities of currency is that it cannot be modeled in a simple way. It is a more integrated approach in that if you are a U.S. investor looking at U.K. currency, looking at the changes in the pound and changes in the deutsche mark, somebody in Germany is looking at the dollar and the pound at the same time and all those relationships have to have some consistency. There could be people that have simple models looking for the U.S. perspective that just do the pound and the mark and maybe have some correlation between them. But if they were able to switch perspective and take their model and apply it from a German perspective, they would likely find they were not looking at the U.S. correctly or U.K. directly. So there is extreme complexity in trying to get everything into balance.

There are some thoughts on currency that people are thinking about. I heard one person say, "You don't have to worry about currency. It washes out in the long run." Many people believe that the currency goes up, goes down, basically comes back together at perhaps the starting point. That's not necessarily true, and I think it is more complicated than that, and certainly the volatility in the short run has a lot of complexity. Hedging, if you want to remove the currency risk. What's the cost of hedging? How does that help or hurt the particular pension plan?

One of the things that is somewhat amusing to me, as I work with a number of different consultants, is that periodically we get our international consultants together from Australia, from U.K., Europe, wherever, all across the world, and everybody has an opinion and expresses an opinion as to what they think future currency changes will be. Well, obviously people feel very strongly about their own country. The Australians always felt Australian currency would do best. U.K. always felt the pound would do best. The Germans always felt the deutsche mark would do best. And of course the U.S., we didn't want to be in second place, so the U.S. consultants always felt that the U.S. would do best. Everybody felt that their own currency was always going to be positively appreciating. Well, economically that cannot make sense because everything has got to be in balance, and if all currencies are appreciating there is something that's got to be a balancing item. For our company, I have to confess, because we didn't have any consultants in Japan, we have Japan as a balancing item, so Japan would tend to be somewhat negative currency in our model. And that's invariably been the case that there is a lot of parochialism on projecting currency.

The Single Paradox is a little known aspect of currency that says that, "If you are a U.S. investor investing in pounds or an English investor investing in dollars, you both can have a positive expected return." And that's very confusing to many people because some think it's a zero-sum game, but in fact Professor Single proved that both parties would have a positive result. It's very tricky to get that result in our model, and we were pleasantly surprised that although we had not specifically built our model to have that result, when we investigated we found it satisfied that criteria.

Insert Graph #1 here

This is an interesting picture that came from an article in *Financial Analyst Journal* in 1998 that gave a geometric interpretation to currency showing that if you are looking at it from the U.S. dollar perspective, Japanese, or German perspective, basically everything has to remain in balance. And if you were to change your assumption for the standard deviation between the deutsche mark and the yen when you are looking at it from the U.S. perspective, that would also change automatically...or implicitly change your assumption for the correlation between the exchange rate for the yen and deutsche mark. So basically changing any one factor...just as a triangle, if you change an angle or you change a side, everything else changes and remains in sync. They came up with a very interesting approach that actually the formulas are completely correct in giving a geometric interpretation to how currency works with standard deviations and correlations. That's something that a model has to follow if it is going to be able to look at currency and results from all different perspectives. And as you can imagine, it is fairly challenging to achieve that objective.

Insert graph #2 here

In our model, we basically have up to six different countries we model simultaneously. We are able to link together currencies, equity dividend yields, and bond yields among all the countries so there's a coordination and a correlation between yield curves and inflation, let's say, in U.S., Germany, Japan, and Europe, and everything is tied together with co-movements at several different points.

Once that is done, we're able to change currency, reclassify asset classes to different currencies, hedge the asset returns, or just provide the returns in local currency. That's the mechanism that allows us to go from any perspective simultaneously so we can take German asset returns, consider them in German currency, consider them in pounds, consider them in dollars, and bring them together under any basis. It is very difficult to do that in a time series model because even if you look at the historical patterns of currency, currency has two sides to it. It is the side that you are

looking at and the reciprocal. So if you're in the U.S. looking at Germany, there's somebody in Germany looking at the U.S. who is looking at one over the currency movement that you're looking at, and both have to be related and correct because it's exactly the same phenomenon. Over the long-term, most people believe that purchasing power parody...the connections to inflation is a very strong force, but in the short term, there is a lot of uncertainty. Purchasing power parody is fairly well demonstrated not to apply in a short-term. So one of the requirements of the model is to not necessarily follow in the short term, but over...somehow in the long term have a strong enough connection to the inflation in the multiple countries so the purchasing power parody holds for all countries, in all combinations over a long period of time.

In modeling the yield curves...and if you remember all those flags we had about all different countries, including developing and developed nations, there are all sorts of issues there. In the U.S., the history has been that yield curve, the Treasury yield curve, which has gone out to 30 years. We've got a fairly long history and a very well calibrated history of yield curves. In other countries, yields only go out to 10 years and that presents some issues. Do you model the 10-year U.S. yields as being linked to the 10-year U.K. yields? Or do you link the 30-year, the longest yields in the U.S., to the longest yields in other countries? So one of the issues is, how do you take into account all the differences among the countries? Historical data includes different durations, different periods, different historical periods. You have the war in Europe affecting some of the markets, so the markets actually closed in Europe, and that affects the data.

Inflation is an important issue in the U.S. The government recently recalibrated and restated price inflation. Your paychecks didn't change. You didn't pay any more for bread or milk...more or less for bread or milk, but the government said that price inflation was now lower than it had been simply by changing the formula. It is very difficult to take that into account in the future because it's sort of an arbitrary change and a theoretical change and doesn’t necessarily reflect the actual price of goods. Well, you can imagine the government in Germany...how do they define inflation? How does Britain define inflation? If you are working with a global model that takes together all the coordination of U.S. inflation and the other countries' inflation, you have to be concerned with what the definition of inflation is in each of those countries. And if you are concerned about some of the yields and looking at real yields, well, real yields are problematic because inflation has its own issues in determining what inflation yield levels are.

In modeling equity, very similar to currency, nobody wants to admit that their country's equity will do worse than any other country's equity. Everybody wants to be number one. There are differences in equity clearly for developing

countries versus already mature countries. Some have the theory that all developed countries should have the same equity risk premium. Equity risk premium is the excess expected return over bond returns. Others might feel there are some differences for different countries appropriate to the characteristics, natural resources, or other characteristics of the country.

In modeling EFI (phonetic), the international stock index, that's a combination of different countries. Now that can be modeled a number of different ways. The traditional is very simply to say, "We know the expected return in standard deviation, the correlations with the U.S., and we'll model it as a very simple asset class matching the returns' volatility characteristics." When you have a global model, it can be modeled in a more complex way with some advantages and some disadvantages. It can be modeled...if we have a model of Europe and Japan, we can have a weighting of those countries' equity returns and therefore derive what the EFI stock return would be based on a weighting of several reasons. That takes into account all the country issues, such as currency issues and any other local issues. One of the problems with that is that if you invest in today's market, you invest 20 percent in Japan, and 80 percent in the rest of the world. If Japan suddenly has a tremendous price increase, well, you can't necessarily rebalance as you would in the portfolio, so you have to take into account that next year Japan may be 40 percent of the total international stock allocation and therefore have a different weight for that future year.

Hedging is a big issue where a pension plan and others may want to find out how much of their international portfolio they should hedge. And with a model that has currency, interest rates, and other aspects, it is possible to then run it through an optimizer and come out with what the hedging ratio is, as well as proposed asset allocations.

In summary, modeling is much more complicated. I consider it to be a branch of financial engineering that may not be the first thing in people's minds when they talk about financial engineering, but the order of complexity is certainly such that it is very similar to the structured products that Prof. Babbel was talking about. It is something that is becoming more common as more and more companies are becoming multinational, looking at all of their pension plans and other financial enterprises from a global perspective. And then they found that the current models, some of the earlier more simple models that are not handling currency and some of the multinational, multicountry aspects correctly, are not able to handle it. So I think this is something that we will see more of as some of the actuaries get into more advanced modeling.

MS. BRICKER: Does anybody have any questions?

FROM THE FLOOR: How do you apply these practically in client situations?

MR. WENDT: In most of the client situations today, each country is done individually, so that we would have separate models for the Netherlands, separate models for Japan, separate models for the United States, for each of the plans in those respective countries. The coming features that I see are that we would have a combined result where we would have coordinated economic models for each of those countries and then be able to express the results in one worldwide result based on wherever the headquarters of that company was. It's not very common now, but it is something that should be coming in the future.

FROM THE FLOOR: (Inaudible) Single Paradox. I did the same thing on international investments where you take a look at the U.S. model (inaudible) the English model, and the U.S. investments are given the premium. How exactly is that consistent (inaudible)? The guy in the U.K. said the U.S. investment was a better investment than the U.K. while the U.S. guy is saying (inaudible).

MR. WENDT (?): Well, that's right and that's a challenge, and we're trying to have a coordinated model that has consistent worldwide assumptions. It is very challenging to do that because we look at all the yield curves at the starting point of each time period. Each country will have different levels of yield curves and inflation, and yet we do try to maintain consistency basically through using risk premium, which is the return over the bonds as opposed to just looking at nominal returns.

FROM THE FLOOR: Right, but not even focusing on diversification (inaudible) real returns (inaudible). Logically I don't see how you can say that on opposite sides of the Atlantic Ocean. Each one is saying the other guy could be better. If that's the case...well, the U.K. guy should be investing the U.K. for the U.S. investor, and the U.S. investor should be investing in the U.S. for the U.K. investor. I mean, what's the point in having...investing across the ocean if each one thinks the other guy is going to do better than he's going to do. Logically it doesn't make any sense.

PROF. BABBEL: I haven't seen these models, and I wouldn't buy them.

MR. GOLD: I'm going to take my transition from Prof. Babbel's presentation, which I would describe as more hard core financial engineering than are the models presented by Mr. Wendt. I want to stress, at the beginning, two of the points that Prof. Babbel made.

One was the Legos building concept. Suppose I put a three-Lego piece here and on top of it a four-Lego piece while over here I take a two-Lego piece and put a five-Lego piece on top of it. If the end constructions are identical, then the prices should be identical. Therefore the price of the three, plus the price of the four, should equal the price of the two, plus the price of the five. Pricing should reflect no further opportunities for arbitrage.

The second Prof. Babbel point was the idea that restrictions imply cost. I do not mean the cost to formulate, enforce or comply; I mean that restrictions imply market inefficiencies. This may be fairly obvious as a general rule, but it is a cost that is closely associated with all forms of financial regulation. Although it is not an open-and-shut case that regulation is necessarily bad, it is clear that regulation has a cost, and we really must compare the benefits of regulations to those costs. In the insurance industry, where Prof. Babbel focuses, it may well be that insurance regulators have created opportunities for Wall Street; opportunities which do no more than allow the insurance companies to accomplish what the insurance regulators won't let them accomplish through the front door.

[Mr. Gold shows Slide 1 at this time]

I will present a financial engineering puzzle that I want the audience to solve.

[Mr. Gold shows Slide 2 at this time]

I ask you to consider a publicly traded stock, which now trades at $100 per share. It does not and will not pay dividends. I ask you to look at two parties, both of whom are in the marketplace and have all sorts of securities available to them. Parties A and B enter into a contract under which A will pay B exactly $1 the first time that the stock trades at $150 a share. I hope that is quite clear. What price should B pay A now in exchange for the promise of that future $1? Is this a subjective question? Is there a single answer?

[Mr. Gold shows Slide 3 at this time]

What kind of variables might affect that answer? Feel free to make any assumptions you think are necessary. If this were an exam, I'd ask you to state them and let us know what you're doing. I'd like you to tell us the risk-free rate, if you think that is pertinent. If you need to assume an equity risk premium, a standard deviation, anything you need, just assume it and state it. If you need options, or futures, or other contracts, just invent a mathematical symbol, pretend you've bought it. In other words, you do not have to perform a Black-Scholes calculation; if you want an

option price just insert a symbol and consider the specification complete.

Well, can anybody solve the problem yet? If you can, and you really know you can, please hold it. But if you have a question, I'd be happy to take it.

[MR. ADAM REESE signals that he knows the answer]

[Mr. Gold shows Slide 4 at this time]

MR. GOLD: Let us try an actuarial approach, familiar to us all. Note that what we have here is a bond. We know what it is going to pay. It's going to pay a dollar. Although we don't know exactly when the dollar will be paid, this really is a zero coupon bond that will pay a dollar at some future time. Let us start to make the assumptions that we think might be pertinent. Let's take a risk-free rate of five percent. Let's take an expected stock return of 10 percent, a standard deviation of 20 percent. Next we assume that we can define a probability distribution expressing, for each future moment, the probability that the stock then first trades at $150. Then we integrate the product of $1 times the probability that time t is when we first hit $150 times a discount for the time value of money.

[Mr. Gold shows Slide 5 at this time]

The key point in the integral, however, is that we are discounting at some rate "i". Suppose, for a discrete example, that the probability that the first hit occurs exactly one year from now is two percent. We take two percent, times a one- year discount of the dollar. We continue for future years or instants. We do a very actuarial calculation. But what rate shall we use for interest to value this security by a discount process? I am asking questions, so feel free to raise your hands and tell me what rate to use. Okay, I'll be rhetorical and indicate that the contract does appear to be a quite risky contract. So it seems that we probably should have a discount rate above the risk-free rate, i.e., above five percent. The contract has an equity component, and it is leveraged. That suggests the rate might be greater than ten percent, but how much greater? Twenty percent? Thirty percent? Perhaps a different rate for each time "t". A term structure approach. Maybe we should use a different interest rate-for every path that the security takes because the amount of leverage varies over different paths even though two paths may hit $150 for the first time at the same time. Hmmm. Is there an objective answer or is this a traditional actuarial modeling problem where actuaries will make a best estimate or make it more sophisticated and make multiple best estimates and put them together? Does anybody have the sense that this is the right way to go, that we just need to solve this issue about "i"? That sounds

like a set-up question, and it is, but does anybody want to defend the idea that you can argue, or develop, or model your way to the rate of discount necessary to solve this problem? You all use these models or delegate them. Every day in every way you are making these discount models, multiplied by probabilities, and summing them up. But nobody for the moment cares to tell me how they would get the rate "i"? Okay.

[Mr. Gold shows Slide 6 at this time]

An alternative to what I've called the "discount approach" is the "hedge approach." This is where, in effect, I link-up with what Prof. Babbel was presenting and with many of the comments from Mr. Wendt as well. I ask the following question (it is the key hedging or replication question): "What asset, combination of assets, or what trading strategy can we use to replicate the contract?" At this time I would really like somebody to give me an indication that they think they know the right answer. Anybody?

[Mr. Gold shows Slide 7 at this time]

Can you figure out a security, a combination of securities, or a trading strategy, that will surely arrive at one dollar when this stock first hits $150?

FROM THE FLOOR: How about a call option?

MR. GOLD: Okay. We have one proposal for a call. A call at $150? Or a call at $149, something of that sort? Of course, obviously the one at $149 gives us much too much because it gives us the dollar at $150.

MR. GOLD: I'm just going to ask the same question one more time. Either we are going to get "ah-ha" and we're going to get the answer, or...

FROM THE FLOOR: How about long a call at $149 and short a call at $150?

MR. GOLD: Okay. Again, that actually mis-prices it because it pays you too much between $149 and $150. Further, you have no time limit. I wasn't terribly explicit about the fact that this contract...I didn't call it an option... had no time limit, but it has none. So I'm not quite sure when you'd exercise or terminate or deliver on that.

[Mr. Gold shows Slide 8 at this time]

One more version of the question, and I would hope it would produce an "ah-ha". The question is, what asset...of all the assets you know...will be worth exactly one dollar when one share of this stock is worth exactly $150? And we have an audience answer.

FROM THE FLOOR: Ah-ha! How about 1/150th of a share of the stock?

MR. GOLD: 1/150th of a share will produce exactly one dollar at the time when these shares first hit $150.

[Mr. Gold shows Slide 9 at this time]

Ah-ha! Ah-ha! 1/150th of a share will be worth one dollar. Well, what is the current price of that perfect hedge instrument? 66-2/3 cents. That security, 1/150th of a share, is a perfect hedge to deliver on this contract that none of us could price with a discount model, and suddenly it turns out to be independent of the risk-free rate, independent of the return on equities, independent of all those assumptions, independent of option formulas, independent of Black-Scholes. Does anybody think that's kind of neat or remarkable?

FROM THE FLOOR: What if the stock never hits $150?

MR. GOLD: Oh, actually that turns out to be quite consistent. The discount to infinity is essentially zero, so if the stock went bankrupt, for example, our hedge asset would have exactly the right value. It would be worth zero and so would the contract. If it's just cyclical but never hits $150, it is also worth zero. It just takes a lot longer to get there.

By the way, the next to the last question on slide 9 is, is that right? I have given away the answer. YES! It had better be right. Note that, if we had a lot of faith in our probability distribution, we could back into a rate for "i".

FROM THE FLOOR: Don't you still own the 1/150th of a share?

MR. GOLD: No, I had to sell it to pay off the $1...if I'm A and you're B, I had to sell it. I had to give you a dollar when that contract first hit $150. We have no time to wait. As soon as the stock price hits $150/share, I sell the fractional share, and deliver you a dollar. I'm out.

FROM THE FLOOR: So this is equivalent to having the stock called?

MR. GOLD: Yes, essentially I had my fractional share of stock called away from me. I owe a dollar now. I had a security worth a dollar. From that point forward, I lose my hedge if I pay the dollar and hold on to the $1/150^{th}$ of a share. I would be a risk taker. Until now I've been a perfect hedger. In fact, if you gave me 66-2/3 cents, I was never exposed to any risk, and if you gave me more, I was a Wall Street financial engineer.

[Mr. Gold shows Slide 10 at this time]

So here are the two frameworks. They are in opposition because they produce different results. The discount approach is a traditional actuarial and accounting standard, and pension actuaries use it all the time. And the hedge approach, the modern financial approach, really does not date back that far. We'll see a little history in a minute. The hedge approach is also known as "pricing by arbitrage", and "no-arbitrage pricing". No arbitrage is the essence of financial engineering.

When the necessary predicate conditions are met, when the transactions can be done unimpeded, the logic is compelling. It is for me. It may or may not be for you, but I can in no way entertain a price other than 66-2/3 cents for this contract.

[Mr. Gold shows Slide 11 at this time]

Now for a little history to show where the actuarial world diverged from the world of financial economics. We missed a significant item, a little thing called Modigliani and Miller, which we now teach on the actuarial syllabus. We teach it as part of the investment material, but we have not allowed it to inform our own discipline. We may use it for assets. We may use a lot of financial economics for assets, but we have not yet applied financial economics to pension actuarial methods and assumptions. Modigliani and Miller in 1958 for the first time used the replication approach in a paper, which is a landmark and which demonstrated the irrelevance...(under certain strong assumptions)...of corporate capital structure. But by 1958, we actuaries already had Trowbridge (1952). We had methods in place. We were beginning to unbundle from the insurance companies. We had separate asset managers, consulting actuaries, and equities. Plan sponsors wanted high equity returns with a traditional level of insurance company volatility and we are so clever we gave it to them, a violation of all financial economics then and since, but

we gave it to them. One landmark actuarial paper in that regard is Hamilton-Jackson (1968), which summarized how to make an actuarial value out of a perfectly good market value.

I want you to recall what was contemporaneous, and where we made a zig when the financial economists zagged. During the 1960s, prominent economists...I believe Paul Samuelson was one of them...were struggling to find "i", to find the interest rate that would have solved that integration equation. They hadn't learned the lessons of Modigliani-Miller at that point because the no-arbitrage and option pricing research lines did not intersect until 1972.

[Mr. Gold shows Slide 12 at this time]

Then Fischer Black and Myron Scholes applied the Modigliani-Miller replication concept to the option pricing problem and derived the Black-Scholes equation.

Black(1980) and Irwin Tepper(1981) made a demonstration that I support, defend, and have written corollaries to (Gold, 2000). They showed that, from the shareholder's point of view, corporate pension plans should be entirely invested in highly taxed fixed-income securities[1]. Despite that, actuarial techniques make equities in pension plans very attractive to plan sponsors and that is the reason sponsors like equities. You'll note that such techniques violate the no-arbitrage concept. Tepper and Black used the no-arbitrage concept to get their results, but the actuarial techniques keep giving favorable results to plans that invest in equity and to actuaries who use the expected return on equity[2] and to actuarial techniques that smooth the variations over time.

Mr. Wendt commented that the currency will wash out. Well, that's the actuarial precept as well. Variations from the expected return will wash out over time. Well, that's wrong in currency, as Mr. Wendt stated it. It turns out it is wrong here too. I believe it will change our profession, and I believe whether or not you accept my presentation, the work the accountants are doing on fair value says that they have learned a lesson. The accountants have adopted the replication framework under the name "fair value" and, although in their recent documents they still exempt *FAS 87* and *FAS 106*, I think it is inevitable that the transparent capital markets' no-arbitrage view will prevail, and then the work of Black and Tepper will become incontrovertible to financial analysts and CFOs alike.

[Mr. Gold shows Slide 13 at this time]

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[1] Under the tax structure in the U.S. in effect then and since.
[2] As prescribed by ASOP 27.

Well, this is sort of redundant. I may have jumped ahead. I won't even bother with this except to note that if there is a no-arbitrage price, and you mis-price something, then you just invite arbitrage. When you invite arbitrage, you may sometimes do it in such a way that your clients don't get injured, but very frequently you invite an arbitrage that actually damages your client. You also create potential conflicts among your various clients, the financial managers, the shareholders and, of course, the participants. At the moment, I am primarily concerned that our actuarial techniques may drive a wedge between managers and shareholders.

[Mr. Gold shows Slide 14 at this time]

Here is a list and then I'm done. This is just a list of arbitrages that have been executed or can be executed today against the actuarial numbers, and in many of these cases, damage is done to the client it purports to help. In the first case[3], the pension obligation bond purports to lower the taxpayers' current pension plan costs. With full transparency and no arbitrage, it is actually damaging to the taxpayers and helpful only to...surprise, surprise... investment bankers, incumbent politicians and, interestingly, to the plan participants who now have greater collateral in the case where there is any question of the credit quality of the municipality making the promises.

Corporate POBs really haven't been executed, but they could be executed tomorrow, in which companies would simply borrow, put the proceeds in the pension plan, invest it, diversify it, and let the actuary use an expected return on assets. The income statement would show the current interest cost on the corporate level and the expected return on that same amount, including an equity risk premium, and you get an immediate boost to earnings. Incidentally, I claim that the NationsBank cash balance transaction[4] is exactly that transaction. Under this transaction, the DB plan accepts the assets and liabilities of the DC plan and then reinvests the assets with a higher equity exposure, takes advantage of *FAS 87*, and produces a higher return. This violates no-arbitrage. This actually injures shareholders. But our procedures are just complicated enough to prevent the consensus analyst and the average CFO from figuring it out. Nonetheless, that transaction damages shareholders. It creates artificial earnings, which are actually, after-taxes, negative earnings.

One quick example, and then I'm done. If I give someone a $200 credit in their cash balance account, and it is vested now and, furthermore, I give them a market rate of return, whether it is the S&P or T-bills or whatever.. there's no

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[3] Gold (1999)
[4] Schultz (2000)

other number for the value of what I have given them but $200, and yet if the actuary values it, he'll value it at $150 because he will roll it forward, say at T-bills, and roll it back at a blended 60/40 mix. Similarly, if I give the participant the S&P and invest in T-bills, the actuary will roll that $200 forward at the S&P, back at T-bills, and come up with a cost of $275. The only correct answer is $200 before tax effects. After tax effects, THE OPTIMAL SHAREHOLDER STRATEGY IS TO PROMISE THE S&P AND INVEST ALL THE ASSETS IN THE T-BILL OR COMPARABLE TREASURY. And with that I will end, and we'll take some questions.

MR. SHELDON GAMZON: Mr. Gold, is the no-arbitrage theory, I mean, is that an absolute figure or is there some recognition that some investors are more sophisticated than others? I mean, take your NationsBank transaction. The theory behind it is that the individual investor may not be as sophisticated as the professional manager, and therefore there is an arbitrage, and therefore there is an opportunity for the DB plan, which utilizes professional managers, to get higher returns than if individuals were to make their own choices. Does that hold any validity anymore?

MR. GOLD: No. The issue is not good versus bad investing; it is not employee choice versus professional investment management. With transparency and the hedging framework, analysts and shareholders can unwind the pre-tax risk and reward tradeoffs made in the DB plan, leaving naked the negative tax implications. I should have noted that my findings are conditional on transparency, the opportunity for all constituents to see the underlying economic reality. Once the accountants impose "fair value" (a good faith effort to represent market value), we should have sufficient transparency. Fair value accounting will make it clear that selling bonds to buy equities is a zero net present value (risk-adjusted) transaction before taxes and a negative transaction after taxes. In that environment, it will be easy for the Wall Street Journal to explain the implications of Tepper-Black.

In the pension arena, the actuarial profession has been a major impediment to transparency. The techniques that produce stable contribution cash flows inadequately represent the underlying financial values of pension plan assets, liabilities, surplus and earnings. Our procedures allow NationsBank to overstate current earnings. This helps the current generation of corporate managers and shareholders at the expense of future constituents.

MS. FAYE ALBERT: I just wanted to ask you to explain something. You said that you would promise the S&P and buy T-bills. So how are we going to be able to pay the person what we've promised?

MR. GOLD: Many of my assertions depend on assumptions that I haven't stated fully. One of these is that bankruptcy risk is not an issue. A great percentage of large corporations in America are substantially free of

bankruptcy risk.

Shareholders of DB plan sponsors own a corporate operating company and a tax-sheltered pension financial subsidiary. With most cash balance plans, the subsidiary owns assets with substantial equity exposure and owes fixed liabilities. This is a mismatch. You assume it will be favorable, but it need not be. My design is also mismatched. In both cases the sponsor has to adjust contributions.

We do not have time to trace the adjustments necessary to derive the arbitrage gain. The details are well explicated in the Black and Tepper papers which I can help you locate if you e-mail me at my yearbook e-address. I am scheduled to present my extensions of Black and Tepper to cash balance plans at the SOA meeting in Dallas next Spring.

MS. FAYE ALBERT: But what I'm thinking about is that the actuary is responsible for the pension plan, not really for the investor in the corporation, so if the corporation now is promising to pay pension benefits to it's employees, don't we have to set up liabilities that will be able to...

MR. GOLD: We need to make the following changes to our accounting. It's really quite simple. The cost of the promise is $200. The cost is the riskless discount of what we've promised, if in fact we have no bankruptcy risk. Then we run a mutual fund on behalf of the shareholders. We could run a perfectly matched mutual fund, which is what a DC plan is. We could run an almost perfectly matched fund in a cash balance plan as well. If we have a promise of stocks and the ownership of stocks, the fair value accounting is zero. If we have a promise of T-bills and an ownership of T-bills, the net promise is zero. But if we have one promise and one investment, just let the accounting tell me what happened. How much did we win or lose? The financially sound multiplier for that win or loss is one. If the T-bills went up three percent and the stock went up five percent, we lost $2 per 100. That should be the entire reflection, not an *FAS 87* earnings artificially created and multiplied by the corporate multiplier, or as Mike Peskin pointed out this morning[5], that's probably the wrong multiplier. The multiplier for capital assets, when we truly identify them, is simply one. I'm saying that pension actuarial methods may injure various constituents, whereas market values create much more efficient opportunities.

ERISA is wrong, too. So what? Our whole profession took Path A in 1958 while the financial economists took Path B, and it turns out that the financial economists got it right. Recall the scientific method. If you make statements

that are not falsifiable, you cannot build a scientific proposition. You must make statements that are falsifiable. The theories of the financial economists are tested every day in market transactions, whereas we make a 30-year projection and, one year from now, we update it to year 31, while spreading the gains and losses over some shorter period. We do not have a falsifiable method. We do not have a science. We have a pretty good engineering practice because we were very clever and designed a very good technique for fixing our errors before the world ended. But it is still engineering and it is engineering built on a non-science.

I know I'm getting on more than a little soapbox, but I feel strongly about this, and I want to convey the sincerity of my beliefs.

MR. ANTHONY DEUTSCH: You've spent a lot of time on what I think is, at least for the moment, (inaudible) esoteric example. I want to make sure that I understand what you're saying in the plain vanilla situation. Are you saying that if the FASB rules...and to keep life simple let's just talk about FASB and not worry about ERISA...if you are talking about the flaws in the accounting system, which at least to set the record straight, are accounting standards not actuarial standards, but your suggestion that the accounting standards that we are all operating under are flawed in a couple of ways...the most prominent is that we don't use market value for valuing assets and that the discount rate that the accounting profession imposes is somewhat inaccurate because instead of using the risk-free rate of return, or whatever it is that you are advocating, it uses some slightly less perfect discount...I mean, those are the two things I've taken away from what you've said.

MR. GOLD: Plus the smoothing of the deviations after the fact. But...

MR. ANTHONY DEUTSCH: In other words, are those the two issues?

MR. GOLD: But the critical element in *FAS 87* that causes biased results is the inclusion of an equity premium in the expected return on assets.

MR. ANTHONY DEUTSCH: But those are the two...I mean, in essence if those two are corrected, forgetting about this NationsBank example though, just in broad strokes, are those the two fundamental...

MR. GOLD: The three issues are non-market values for assets, anticipating equity premium returns and smoothing

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[5] See Peskin and Boudreau (2000).

the results. Further, we should not be reporting earnings. We should be reporting a mutual fund net asset value. The only operating[6] cost of the pension plan is the riskless[7] value of the promise. Your question implies that the accountants imposed the "expected return on assets" provision of *FAS 87*. If, however, you review the history of *FAS 87*, you will find that the accountants proposed to use the market value of assets and a riskless return on assets. The statement now calls for a market related value of assets and an expected return on assets based on the anticipated investment strategy. These changes came from the actuarial side and were supported by statement preparers. The composite effect is the recognition of expected returns on risky assets before the risk is acquitted. You will see this in all the pension actuarial writings back to the 1960's and you can find it reiterated and formalized in ASOP 27 which is irrevocably flawed thereby. This creates a bias towards overstated earnings. Had the riskless rate of return approach prevailed (even with a smoothed asset value and smoothed gains and losses), the bias would not exist. Note, however, the smoothing would still be too opaque to make Tepper-Black persuasive.

The proposed fair value accounting rules specifically observe that pricing liabilities by reference to expected return on assets is no longer any good, and the accountants got that from the financial economists. Somewhat arbitrarily and for practical reasons, the latest proposal exempts pensions and health care from the new framework, but this is temporary.

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[6] See Patricia McConnell comments in McConnell and Reese (2000).
[7] Continuing to assume no bankruptcy.

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