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CAPITAL ASSET PRICING MODEL

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- Single-index model
- Multiple-index model
- Impact on risk

MR. JOSEPH J. BUFF: We have a panel of three speakers. None of the three are actuaries, but they all work in areas revolving around key aspects of investments and the insurance industry.

The first speaker is Jeff Margolis. Jeff has a bachelor's degree in economics from Cornell University and also received his MBA from Cornell in finance and accounting. He began his career at Arthur Young, where he earned a CPA. Since 1983, he's worked at Continental Asset Management, where he also early on achieved his Chartered Financial Analyst (CFA) credential. He's a senior vice president there, and his responsibilities include supervising the policy and strategy group at Continental Asset Management. In the last couple of years, he's become responsible for business development. In case you're not aware, Continental Asset Management is a wholly owned subsidiary. He's been involved in property/casualty companies, which is an area where the capital asset pricing model has been applied extensively.

The next speaker is Scott Wittman, who works at Vantage Global Advisors. Vantage Global Advisors is also an asset management firm that is wholly owned by Lincoln National. Scott holds a bachelor's and a master's degree from Indiana University and is also a CFA. He is a senior vice president and is a portfolio manager at Vantage. After we have Jeff give an overview and talk about property/casualty applications, Scott is going to talk about some applications of the capital asset pricing model in the international investment environment.

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Our third speaker is Vernon Budinger, who currently works at Global Advanced Technology. Vernon has a bachelor's degree in finance from the University of Hawaii and also has an MBA from New York University. He began his career as a portfolio manager at Denny & Denny in Hawaii, and then spent a while working at Citicorp Securities Markets, where he was involved in fixed income research and fixed-income sales. Now since joining Global Advanced Technology, he's working as a consultant in the financial strategies group. Vernon is going to talk about some applications of the capital asset pricing model in the fixed-income environment of portfolios that are being managed in the context of multiasset classes.

So among our three speakers we're going to have a very broad general overview of aspects of the capital asset pricing model, looking at it from life and property/casualty, to international investments with some emphasis on equities, to domestic U.S. investments with some emphasis on fixed-income securities.

MR. JEFFREY ROBERT MARGOLIS: I have the dubious distinction of starting this panel with an overview of the capital asset pricing model itself before I get into my specific application, and I've chosen to review very briefly what the model means in a nonquantitative way, because I couldn't hope to compete with all of you on quantitative skills. I'll try to describe the concepts real quickly and then get into the property/casualty application that I've been involved in.

As I said at the beginning of the panel, my part is divided into two sections: an overview of the model and the application to the property/casualty industry. And, by the way, my application to the property/casualty industry, I believe, in theory and concept can be equally applied to the life industry. Just some of the details will be different. So let's get started with the overview of the model. What is the capital asset model? Quite simply, it's a model that is used to relate investment risk and return. And most of you probably know that one of the theories of investments is that high risk means high return, and lower risk means lower return. The model tries to relate the two in some meaningful and predictable way. I will describe three basic tenets that I think about.

First, the model says that, if you can diversify risk away by buying several securities, then you should not be rewarded with extra expected return for that. You should only be rewarded for extra expected return if you put together a portfolio that has a certain risk level that cannot be diversified away.

Second, the model is typically linked with the efficient market theory that says that you have an expected return level for a portfolio under the model, and then markets essentially efficiently price securities. And the implication of that is that passive investment tends to be best even though empirically that has not necessarily been the case in many instances. Third, the model says that, by putting together a certain portfolio of securities with a certain risk level, you can have a certain expected return level, and by altering that portfolio mix, you change the risk and return. The capital asset pricing model can predict that relationship. And so there are two ways of really stating it, you're trying to maximize expected return for a given level of risk, and of course, the exact corollary of that is you're trying to minimize risk for a certain given level of expected return.

Now the capital asset pricing model has undergone a lot of controversy since it came into existence in the 1950s. Beta, for those of you not too familiar with the model, is really the risk factor within the model, and a portfolio with a beta of one has the risk of the market. A beta greater than one is a volatility higher than that of the market, and lower than one is less than that of the market. Beta is used in the model as the risk predictor, and therefore, the expected return predictor; the higher the beta, the higher the expected return. Empirical studies over time have never borne this out exactly, and so that's one of the controversies. One of the empirical studies that's been done recently has shown that beta really doesn't have any relationship to expected return, but a lot of the studies over time have shown that beta has some relationship, but not nearly as strong as would be predicted in the capital asset pricing model.

Another factor that creates controversy is that there are many anomalies that exist in the market that create returns under empirical studies that are not related to the returns predicted in the market. I call one the Warren Buffet factor. Warren Buffet is one of the great investors over the last generation, and Warren has been able to produce much higher returns over time than the efficient market theory would predict. And there are maybe a handful of examples of investors that have consistently been able to do that. So there are exceptions to some of this efficient market in capital asset pricing model theory.

Another controversial factor is international returns. There was a time that international returns were greatly in excess of the risk level predicted under these types of models, and essentially, you could get more return and less risk under a lot of the studies that were done.

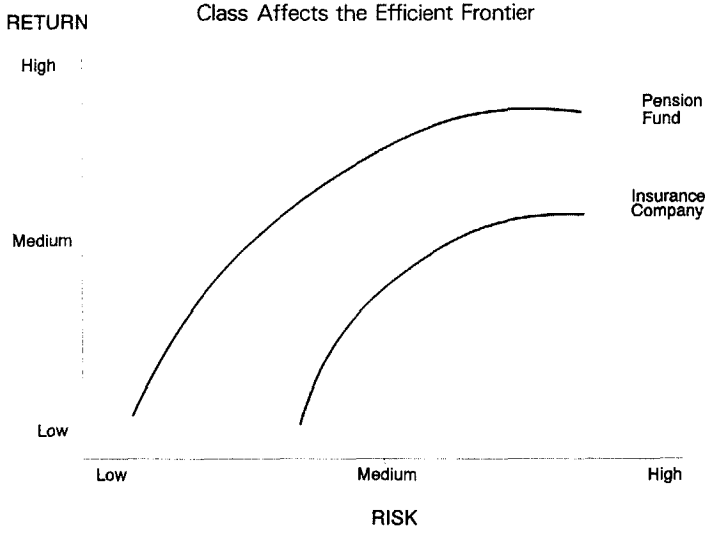
One example of a specific anomaly is called the calendar effect. As you get to year-end, there are crazy things oftentimes that happen in the market. For example, in the stock market, January is one of the highest return months consistently, not every year, but over a long period of time. So that would be something that would be an anomaly in terms of the efficient market theory in the capital asset pricing model. But my conclusion from all this basically is that, even with all these exceptions and anomalies, the capital asset pricing model really is a very useful framework to design portfolio structures. It's just very elegant and useful to have an understanding and a framework of risk and return. And even if the exact model has not been borne out exactly through empirical studies, it's a very useful framework.

I'll get into a little bit more of that as I go on, but now I'd like to get into the application that we've used it for. I'd like to get into a specific example in the P&C industry and talk about the capital asset pricing model itself in the context of that example. What we've used it for in the property/casualty industry is asset allocation, and we've worked in conjunction with a model developed at Salomon Brothers by the bond analysis group there under Fred Weinberger. Basically this uses the traditional mean variance analysis contained within the capital asset pricing model, saying that the mean return is related to the variance of return, or risk and return are related. You have to combine asset classes and look at the means and variances of returns and the correlations between the asset classes to produce what's called an efficient frontier. But the difference in the application that I'll talk about from the traditional way of looking at it is that, when you're talking about an insurance company -- and

again, the application here is P&C, but it could be equally used on the life side – the main focus should be on surplus returns not on portfolio returns. And that's how you dovetail this type of analysis with asset/liability management. Really the only thing that matters is the risk and return contained in your surplus. Asset and liability management tells us you could have certain characteristics of risk and expected return in your portfolio, and combined with certain characteristics on the liability side, you may not be maximizing the risk return tradeoff you want for your surplus. So when dealing with asset allocation in an insurance context, you really should couch it in an asset/liability framework. So, therefore, P&C companies when looking at asset allocation and using this analysis for different asset classes should take into account underwriting. We take into account underwriting as a negative asset class, essentially the flip side of the balance sheet, and we end up looking at liabilities as a negative asset class and looking at the expected return risk and correlation between asset classes and liabilities. And that's how you get at the surplus expected return and risk.

Now Chart 1 is just an illustration. The curves are nice and neat. They never come out that way, but basically these are diagrams of the traditional efficient frontier. Look at return on the Y-axis and risk on the X-axis. I just used for illustration low, medium, and high for each.

CHART 1
Including Liabilities as a Negative Asset Class Affects the Efficient Frontier



The typical users of these types of models are portfolio managers for pension funds. A pension fund has an efficient frontier that looks something like that nice, neat curve although it never is quite that nice and neat. But basically this says, if you start out at the lower left where you have a portfolio at low risk and low expected return, let's say a 100% T bills, for example, and you add different asset classes to that, for a period of time you can go up that curve rather steeply and add a lot of return

without adding a lot of risk. And then as you go out on the curve it bends to the right, and now as you're adding risk to your asset classes, you're not picking up the same returns for element of risk. For a second, just focus on the pension fund curve, ignore the insurance company curve. This is called the efficient frontier. It says that, if you have portfolios you've put together that are to the bottom right of that efficient frontier, then you have what is called inefficient portfolios, and the reason they were all inefficient is that you can move up to the curve without adding risk, but gaining return or move to the left by keeping the same return and lowering risk. Therefore, you would never choose a portfolio under this theory that's not on the curve. There are no portfolios outside of the curve, on the upper left. So without portfolios on the upper left and with inferior portfolios on the lower right, you would only choose portfolios on the curve and which portfolio you would choose would depend upon your own risk return tradeoff, your own risk tolerance. Now the reason it goes up sharply at the beginning is that traditionally you can add stocks, sometimes bonds, and diversify your portfolio so that you're adding a small amount of risk while you add a lot of expected return and then that flattens out later on.

The insurance company curve to the right really doesn't do justice to what's going on. I'll get into an example, but the point of this is that you will have a different efficient frontier for an insurance company when you focus on surplus risk and return as opposed to portfolio risk and return. And for each insurance company it will be somewhat different, particularly if you have vastly different lines of business. My example that I'll get into is a medical malpractice one. And just for a minute I'm going to put some numbers up here (Table 1). This is a correlation matrix, and these are some results of an actual assignment that we did for a client of ours that's a medical malpractice company. These statistics were gathered by looking at statements going back to 1977. There are four asset classes and one negative asset class we call underwriting, which is basically the writing of the medical malpractice business. You have those categories on the left as well as the top. For each part of the matrix you see the correlation of expected returns between the two asset classes. Obviously, T bills have the perfect correlation with T bills. But over this period of time T bills only had a 0.17 correlation with intermediate governments and actually a negative correlation with long-term governments, a negative correlation with the Standard & Poor's 500, and a mildly negative correlation with underwriting.

The interesting line to look at in Table 1 is the underwriting line. If you go to the bottom and across, you see an extremely strong negative correlation between underwriting and both intermediate and long-term government bonds. The reason for that is not an asset-allocation issue. It's really an asset/liability management issue, and that says something that we all learn through asset/liability management. If you manage the duration of your underwriting closely with the duration of your bonds, then you're going to get a hedge to your underwriting if interest rates move. That's really what's going on here. It's almost equal between intermediate and long-term governments. If we had a much shorter-tail line than medical malpractice, the negative correlation would be much weaker with long-term governments. It would remain strong with intermediates.

If you go out further, another interesting point is the correlation between underwriting and the S&P 500, and there you have somewhat of a hedge, but obviously it's much less of a hedge than with bonds because a lot more things affect stock returns than

interest rates. So these are some of the statistics we used in creating the efficient frontier when we're performing asset allocation analysis for our medical malpractice writer.

TABLE 1
Medical Malpractice:
Asset Class Correlation, Including Underwriting

	Treasury Bills	Intermediate Governments	Long-Term Governments	S&P 500	Underwriting
Treasury Bills	1.000				
Intermediate Governments	0.170	1.000			
Long-Term Governments	−0.046	0.935	1.000		
S&P 500	−0.078	0.345	0.419	1.000	
Underwriting	−0.037	−0.950	−0.962	−0.434	1.000

Charts 2 and 3 diagram the correlation between bond returns and underwriting and stock returns and underwriting, respectively. The total return on medical malpractice underwriting is not just the combined ratio, but it's really the discounted combined ratio if you will. It includes accounting for the investment that would build up. Basically you see a very strong negative correlation.

So what's going to happen, of course, in the efficient frontier is that, as you add stocks to the portfolio in this case, you are going to get some diversification benefits away from bonds, but you're going to reduce your asset/liability management hedge, and therefore, you're going to be adding a lot more risk to surplus.

So let's take a look at what that efficient frontier looked like in this example (Chart 4). Basically you have this very strong backward-bending efficient frontier. If you look at the bottom where we have the first dark square sort of in the middle on the bottom, that's a 100% T-bill portfolio. Your expected return on surplus is going to be the lowest for a 100% T-bill portfolio, but the risk is relatively moderate to high. The reason is that, if you're focusing on surplus returns, you've created a tremendous asset/liability mismatch with a long-tailed business in a short-term portfolio. So you have a lot of risk in this portfolio if interest rates drop because you've put together a very short-term portfolio with tremendous reinvestment rate risk where you have long-term claim payments. And, so as you move upward to the left you're actually getting what appears to be a free lunch by adding return and lowering risk, but what's really happening is, you're focusing on surplus returns rather than portfolio returns and you're creating a better asset/liability match. You move all the way up to the left, and you have 0% T-bills, 57% intermediate bonds, 38% long-term bonds, and 5% common stocks. That is really the lowest risk portfolio in this analysis if all the assumptions are correct. And then you start moving out and increasing risk as you move out to the right and it's fairly sharp at that point. This is a very sharp curve, and in the pension fund you typically wouldn't have as much of a backward bending, but you wouldn't have as flat a curve. You'd be moving up more, so you get a lot more benefit for adding the other asset classes. So that second point that I described to you should at least do, and you should start doing more as you're adding return without adding too much risk until you start adding more risk than return.

CHART 2
Medical Malpractice: Relationship Between Bond Returns
and Underwriting Returns

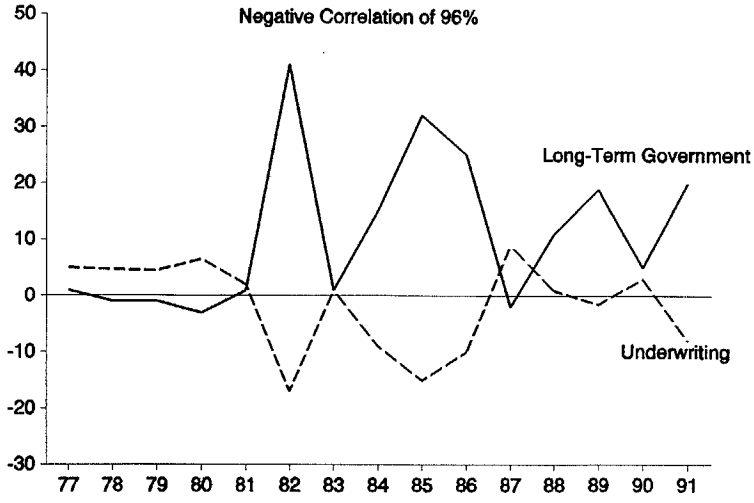


CHART 3
Medical Malpractice: Relationship Between Stock Returns
and Underwriting Returns

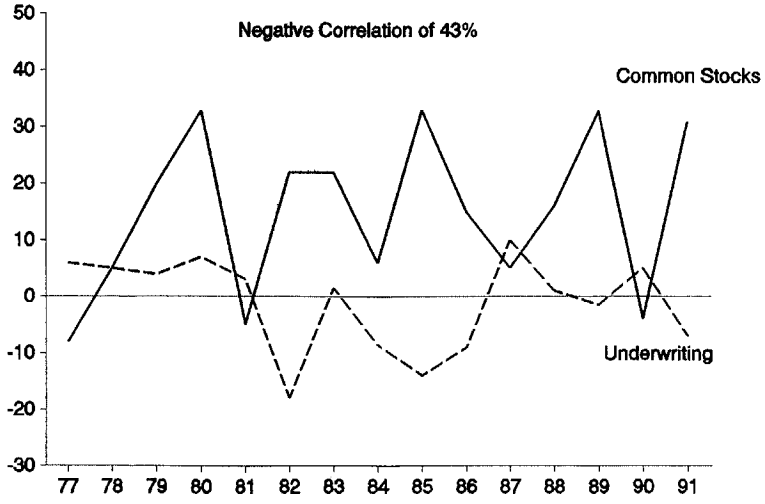
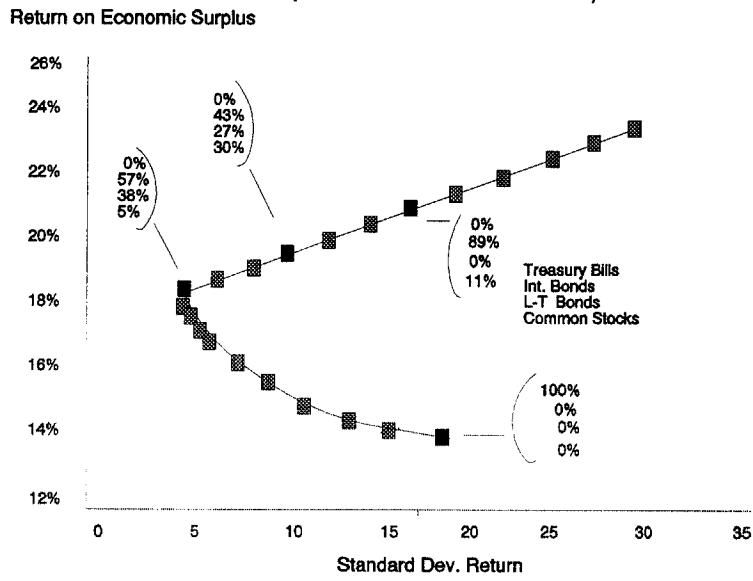


CHART 4
Medical Malpractice Asset Allocation Analysis



The conclusions that I bring to this are that, although not perfect, the capital asset pricing model provides a very useful framework for asset allocation even within insurance companies when applied to surplus. You must incorporate underwriting results to get the right results to really focus on the surplus returns. Finally, the Warren Buffet effect essentially claims that the market isn't totally efficient. This is a useful analysis to predict the expected returns based on prior statistics, but in a portfolio management shop where you feel that the market isn't totally efficient, you could add additional returns over and above that with proper portfolio management if you don't believe the efficient market hypothesis completely holds.

MR. T. SCOTT WITTMAN: What I'm going to talk about is the application of the capital asset pricing model to global investing. In order to do that, I need to first touch on an issue called market integration. I will first introduce the theory of international capital market integration and some of the implications of it in terms of valuing assets. To illustrate the use of capital markets integration I will explain the three basic alternatives, the way we specify the model, and some potential problems with each of the three alternatives.

International capital market integration is a mouthful, but it simply indicates the degree to which international markets behave as a unified single marketplace. There is a continuum on which we may fall with respect to integration. On the one hand, we have complete segmentation indicating that capital markets are not integrated, that each market behaves in a very idiosyncratic manner. Each local market, for instance Japanese equities, behaves and responds to local individual factors. On the other end of the continuum is perfect integration. This would mean that all capital markets behave in the same way and respond to the same factors. As this continuum implies

we have three alternatives: We can have complete segmentation, we can have perfect integration, or we can have something in between.

In the case of complete segmentation, markets could operate on either a regional or a country-by-country basis. Global investments and investment analysis would be structured accordingly. You would need to have people in each market who could understand the local factors and respond accordingly. If the world is perfectly integrated, then the same factors drive returns across the whole spectrum of markets. In the integrated case, it is not as important to have analysts in each local market. If the world is completely segmented, then domestic factors are the most important. If it's perfectly integrated, then international factors are paramount. In terms of the importance of individual factors, if the world is segmented, the factor importance will vary significantly from market to market.

I'll give you an example of that. Oil prices might be very important in the U.K. market and not important at all in the Japanese market if the world is completely segmented. If it's perfectly integrated, then the same factors would apply over the entire globe. Oil prices would be important in every market and would have by implication the same sort of significance in every market.

There are three basic alternatives: The world is segmented, it's integrated, or it's somewhere in between. Perhaps to clarify what each of these alternatives means, I could show you a couple of quick examples of how this issue plays out in determining where to invest globally. I have an actual research report from Salomon Brothers that says: "Facing poor earnings prospects U.S. and U.K. equities will make no headway," and "We recommend reduced exposure to Japanese equities where the overvaluation relative to bonds is currently extreme." Finally, "Interest rate cuts will fuel a rally in Spanish equity prices." What is this an example of? This is an example that at least implicitly the authors feel that the markets are completely segmented, because for each of the markets they're talking about a specific factor, which is local in nature, that affects the return of that particular market.

Another example would be this one from Merrill Lynch that says: "Technical factors favor the three-year issue over the 30-year U.S. bonds." "The long end U.K. gilts will continue to be adversely affected by concern about underlying inflation." "The 10-year area of the German curve continues to look a little expensive relative to short maturities." In each case the analysts use a specific factor which is local to that market as the determining factor in assessing whether the market is attractive.

What are some of the attributes of a segmented world?

The segmented analysis of markets focuses on one key factor that affects each market. Market opinions are often based on that one factor. Factors are inherently local in nature and not global. The factors change frequently. This month, a technical factor may be most important and the following month a valuation factor may be paramount. Implicitly this type of analysis combines the asset and the currency decision. If Japanese equities are determined to be attractive, both Japanese equities and the yen are implicitly attractive. In a segmented markets framework, the two decisions are combined often without the realization of the inherent currency decision.

The potential problem with the segmented approach is that the focus is on one factor. If the wrong factor is chosen, investment results suffer, particularly since implicitly 100% of the weight is on the one factor. Another problem is that the focus is primarily on one country. Focusing, for instance, on Japan, investors may not be considering global influences. This type of analysis also makes it very difficult to compare across countries. Think back to some of those statements that I read from the brokerage firms. It would be very difficult in that type of analysis to determine the relative attractiveness of Japanese stocks versus U.S. stocks because the factors under consideration are specific to those individual countries. In a segmented markets framework, it is almost impossible to make cross-border comparisons.

Some examples of the integrated approach would include this report from Phillips & Drew. It says, "The recent gains in the U.K. and Japan may now leave them vulnerable to a setback." What are they doing here? They are comparing a single factor across markets. They use recent performance as a factor in both the U.K. and the Japanese markets in terms of assessing their attractiveness.

Morgan Stanley lists the price/earnings (P/E) ratio and the dividend yield for five countries (Table 2). At least implicit in this type of analysis is the notion that the same factor is applicable and has the same weight across all five of these countries. Based on the analysis, you might conclude that the most attractive market is Belgium on a P/E basis, and Spain on a dividend-yield basis. The attributes of integrated markets are that it is possible to identify several key factors for each asset class. These factors are comparable across borders. Equal or subjective weights can be applied to each of the factors.

TABLE 2
Eurostrategy
Market Valuation and European Model Portfolio Weightings

	P/E - 1990	Dividend Yield - 1990	EPS - 1990
Belgium	12.12 X	4.34%	$ 7.00
France	12.90 X	2.99%	$14.00
Germany	16.57 X	3.01%	$12.50
Italy	12.89 X	2.72%	$11.00
Spain	12.43 X	4.50%	$10.00

One of the problems with this type of analysis is that the factors may not be directly comparable. An example of this problem is the difficulty in comparing the P/E ratio of Japanese stocks, where the accounting standards are very different, to the P/E ratio of U.S. stocks. Another problem is that weights may not be equal. To use the Japanese market as an example again, if you talk to Japanese investors, they'll tell you that valuation criteria like P/E are not very important in their market. We find when we test empirically, that is, in fact, the case. Valuation type of factors are very important in the U.S. and to a lesser degree in the U.K., but they do not appear to have the same importance in the Japanese market. A final problem with this approach is that the focus is on the asset class and not on the country. Certain political or cultural events can affect the returns to a particular country's market, which are ignored in this type of framework.

An example of an approach that falls between the extremes of fully integrated or fully segmented is reflected in Table 3. This analysis uses a variety of factors such as valuation, technical, inflation, economic growth, monetary policy, fiscal policy and trade balance for each country. Different weights are assigned for each factor. Using valuation as an example, it represents 25% of the weight in the U.S., while only 10% in Japan. This approach uses valuation as a factor across all markets, but the importance of the factors varies between markets. This reflects a partially integrated approach to global investing.

TABLE 3
World Equity Market Matrix
Score: 1-10 (10 = Best)

Category	USA	Japan	U.K.	Germany	France
Valuation	5 (25%)	6 (10%)	9 (25%)	8 (20%)	3 (15%)
Technical	2 (5%)	2 (40%)	1 (5%)	1 (5%)	4 (5%)
Inflation	9 (10%)	8 (5%)	4 (15%)	10 (25%)	5 (15%)
Economic Growth	7 (15%)	9 (5%)	3 (10%)	5 (20%)	9 (25%)
Monetary Policy	9 (35%)	3 (25%)	5 (20%)	1 (15%)	6 (25%)
Fiscal Policy	5 (5%)	9 (10%)	4 (10%)	4 (5%)	4 (10%)
Trade Balance	3 (5%)	7 (5%)	6 (15%)	5 (10%)	2 (5%)
Composite	6.85	4.25	5.50	6.00	5.65

I have tried to present a balanced view of international capital market integration. Our view, however, is that markets are partially integrated. Using this approach, we identify several key factors for each country and asset. We determine the proper weights for each of the factors from a local market perspective. We allow different factor weights in different countries. In this way, we are allowing for the fact that some economic factors may be more important in the U.K., for instance, than they are in the U.S. This approach facilitates cross border comparisons and can incorporate some economic, political, cultural, and regulatory differences between markets. We recognize that different markets may have different sensitivities to the same factor.

What are some of the problems with the partially integrated approach? We have listed a few, and we prefer to call them potential problems. The first potential problem is that factors and factor weights may not be stable over time. We certainly find this to be true although we have found that there seems to be a tendency for the factor weights across countries to converge over time. This convergence results in valuation, for instance, becoming more important in Japan. Another potential problem is regional integration. For example, the Pacific Rim might be regionally fully integrated or global industries such as the oil industry may be fully integrated. There is certainly evidence that oil stocks, despite differing home countries, tend to be priced the same. If you're evaluating Royal Dutch versus Exxon, they do appear to be fully integrated. The market prices them in much the same way even though they have different home countries. Finally, there is a problem of illusion of accuracy with this approach. For instance, all the numbers I have just shown you appear to be objective. Actually, the numbers in the example were derived in a very subjective process. When numbers are used, the results often seem precise.

I hope in the first part of this presentation that I have convinced you of three things: (1) International capital market integration theory is important. (2) It is unavoidable. If you are investing internationally, this is an issue that you have to have a view of. (3) The issue of the actual degree to which markets are integrated is unresolved. We cannot precisely determine where on that continuum we lie today. Are the markets completely segmented or fully integrated or somewhere in between? We have an opinion that is supported by data. However, this is really an unresolved issue.

To demonstrate how international capital market integration works in practice, I will apply it to the capital asset pricing model. This was mentioned briefly in an earlier presentation. This is a simple formulation of the basic capital asset pricing model. Expected return is a function of the risk-free rate; beta, which is a risk measure; and the market-risk premium, which is defined as the expected market return minus the risk-free rate. As Jeff mentioned earlier, one of the implications of this formula is that return is linearly linked to risk. The only way to earn higher returns is to bear higher risk. In the capital asset pricing model framework, earning a higher expected return requires a higher beta.

Table 4 shows a simple example of the capital asset pricing model computation for an individual company. The example is actually Caterpillar Tractor. The risk-free rate is assumed to be 3%; we know based on historical data that the beta with respect to the U.S. market of Caterpillar Tractor is 1.1. It has about 10% more risk than average stock. By definition, the average stock has a beta of 1.0. Assuming the market earns 9%, you would expect Caterpillar Tractor to return 9.6%, based on the capital asset pricing model formula.

TABLE 4
Capital Asset Pricing Model
A Simple Example

Caterpillar Tractor

$$\text{Expected Return} = \text{Risk-Free Rate} + \text{Beta} * \left[\text{Expected Market Return} - \text{Risk-Free Rate}\right]$$

$$9.6 = 3 + 1.1 * \left(9 - 3\right)$$

This is a simple domestic example. Globally you need to make some changes. First, a new definition of the market is needed. If the world is segmented, the market is as I just explained in the Caterpillar Tractor example, the U.S. equity market. If the world is integrated, it is necessary to consider the wider world. The market becomes the global marketplace including currencies. Beta, the measure of risk, is actually computed as the covariance of the asset and the market divided by the variance of the market. Beta obviously, is affected by definition of the market. If the market is a local market, the beta is computed relative to the local market. In an integrated world, it would have to be computed relative to a global benchmark. Finally, the risk-free rate needs to be redefined as a global risk-free rate. In the equation of the capital asset pricing model, there are only three variables, but all three variables change if you move to a global marketplace. The risk-free rate for a domestic U.S. application of the capital asset pricing model is the rate on short-term Treasury bills. If an integrated

global-type solution is desired, the risk-free rate is a combination of interest rates over the entire world adjusted for the currency effects.

What are some of the implications of applying the capital asset pricing model globally? First, if local investors set prices, then assets may be mispriced. Using again the example of Caterpillar Tractor, if prices are set solely by U.S. investors only considering U.S. investments, they will use the wrong risk free interest rate, the wrong market, and the wrong beta. Using the wrong inputs can cause assets to be mispriced. If markets are truly integrated, that implies global money flows. This is actually one of the reasons why the markets probably are not completely integrated. Because of restrictions on global money flows and what you might call a preferred-habitat-type of problem, investors tend to invest in their local markets. We probably do not have global money flows of the size needed for markets to be perfectly integrated. The capital asset pricing model may not apply globally because of this investor myopia. Finally, there have been a number of empirical tests of capital asset pricing model. None of the tests can conclusively prove that we do have full integration of capital markets. It seems that there is incomplete integration of capital markets.

What does this mean when you consider investing globally? First, I hope I have convinced you that a key aspect of global investing is deciding what your view is of this issue, of segmented versus integrated capital markets. You need to have an opinion on that issue, and your opinion on that will affect how you structure your international investments. Second, if you're going to apply models such as the capital asset pricing model, you have to have a view of this issue. And, third, if the capital markets are incompletely integrated, then global investing can be what is called a free lunch. By free lunch, I mean that you can achieve a higher rate of return for the same risk or the same rate of return with less risk. Remember I said earlier that the only way you could achieve a higher rate of return was to take more risk. Historically it has been true for global investors that they have achieved higher rates of return with lower risk levels. Historically, that has been the greatest attraction of global investing.

MR. VERNON H. BUDINGER: Joe asked me to cover capital asset pricing model applications for portfolio management. So we'll be dealing with that aspect of managing portfolios within the capital asset pricing model and, also, when a capital asset pricing model is used in a companywide framework for managing multiasset portfolios integrating the fixed-income portfolio into the multiasset portfolio. So what I'm going to do is look at some of the assumptions behind the capital asset pricing model and the implications for the insurance industry. Then I'm going to be talking about looking at the risk free rate for the capital asset pricing model and talking about deriving an optimal risky portfolio. And, finally, we'll look at using this approach for asset allocation within the fixed income sector and companywide investment management.

First, the capital asset pricing model has some mathematical assumptions that you're probably familiar with, and it basically assumes that the first two moments, the mean and the variance, of the distribution effectively describe all the factors in the risk and return tradeoff. Second, it assumes that investors have a quadratic utility function, and what that means in plain terms is that investors are risk adverse in that they

demand higher return for incrementally higher amount of risk in their investments and that you can describe this utility function in a mean-variance sense.

Now what implication does that have for asset/liability management in a sense of the insurance industry? Well, the final assumption behind it is that investors have unlimited resources with which they can withstand losses. In other words, not only can they go down to zero net worth (surplus), but they can also continue to go out and borrow money until they can turn their investments around and continue to play the game.

But if you look at the insurance environment in the real world, we have what's called risk-based capital, right? From what I understand that's one of the topics of another session that we're competing with and something that's hot on everyone's mind right now. Basically you have limited resources. You're highly constrained and very regulated. In preparing for this topic, I was reading a piece from the *Actuarial Digest* written by John Dawson, and he was mentioning that you don't even have to get down to zero surplus. In fact, you don't even have to really get below some risk-based capital constraint. If you're heading that way and you have negative returns and you're fairly close, you'll start getting what he called regulatory attention. I love that regulatory word. I once worked for Honolulu Federal and I don't know if you're familiar with it, but it did get regulatory attention. So I sympathize with anyone who's ever had regulatory attention.

So basically in an investment behavior sense, what you see from investors who are in asset/liability management framework is a more conservative approach. They evaluate company returns on surplus using extreme scenarios, trying to figure out exactly where they could possibly run into trouble with risk-based capital, trying to assess the probability of becoming insolvent, and evaluating the implications of regulatory constraints. In your asset/liability modeling and asset allocation you have to take into consideration the effect on risk ratings in a regulatory sense from buying higher-risk assets. So what does this mean as far as the capital asset pricing model? Does it mean that it's absolutely useless? I think we need to take a step back from the capital asset pricing model and ask, what is it trying to tell us? It gives an efficient frontier, which is kind of an opportunity set for looking at investments. It gives us a risk-free rate from which we can evaluate the riskiness and the return from the rest of the investments, and it gives us a framework for evaluating our opportunities.

So I'd like to discuss an approach that we've taken at Global Advanced Technology (GAT). The first question really is what is your risk-free rate, and I would like to illustrate a point. This is a true story. I was driving across the desert with my wife's family, my father-in-law and mother-in-law, and we saw some encampments of mobile homes out in the middle of the desert. I was wondering what those people were doing out there, and my father-in-law told me that some of the people didn't really have good investments in life insurance policies and couldn't afford a nice home and that they were living in the desert in mobile homes and got together in these caravans. And he said, "If my daughter ever has to live like that, I will come back out of my grave and haunt you for the rest of your life." I decided right then that I should calculate just how much money I'd have to earn in order to not live like that and that became my risk-free rate for investments.

Basically that's the same point we're trying to make for insurance companies. Chart 5 is a diagram of the capital asset pricing model, and basically the idea is that you have your risk-free rate, and the line between the risk-free rate and the target point on the efficient frontier becomes the line for allocating your assets between your risk-free rate and your optimal risky portfolio, which would become (in capital asset pricing model terms) the market index. If you have a five-year GIC what's your risk-free rate? It's the rate at which you can invest those cash flows in Treasuries and exactly match those cash flows. That's not going to be the same risk-free rate as for say a 20-year insurance policy. So in looking at the diagram, there is actually a risk-free rate right now for one year, and there is a risk-free rate for the 30-year. And if you notice it brings up several kind of problems for the capital asset pricing model. Number one, what is your optimal risky portfolio? And, number two, this is kind of nice, because I get a lot of the same results as Jeff does through another approach. The higher your risk-free rate, the further you go out on the efficient frontier. This line is the efficient frontier, the tangent point for the line between the risk-free rate and the frontier is out on the efficient frontier. And then there's another subsequent problem, too, in that this efficient frontier doesn't always stay the same. We generated these returns using corporate bonds and Treasuries, and basically we used our arbitrage-free pricing models and a normal distribution, and we've priced the bonds at a one-year horizon, which would be consistent with using a one year risk-free rate (Chart 6). (We assume the future curve will equal today's base-case curve). And if you notice the slope in the line, the frontier is steep (sloping up) because the yield curve is so steep right now and your base-case assumption is that the yield curve one year from now is going to be today's yield curve. So you're earning a lot of return from riding down yield curve as you go out the maturity spectrum.

CHART 5
Capital Asset Pricing Model

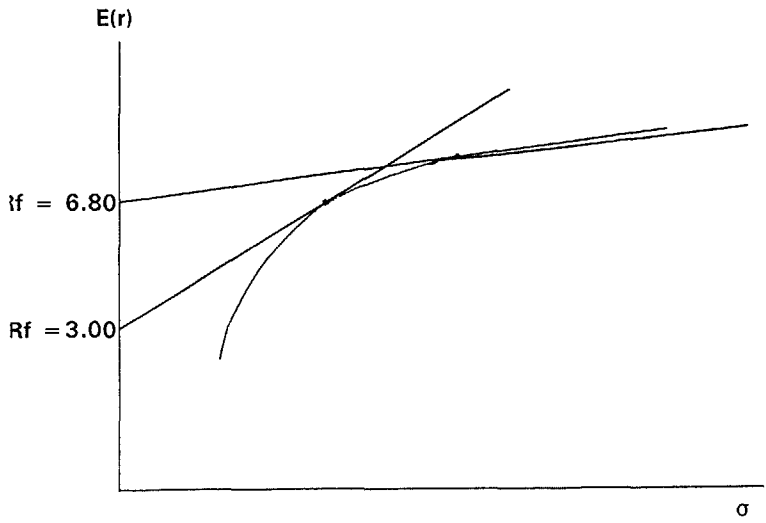
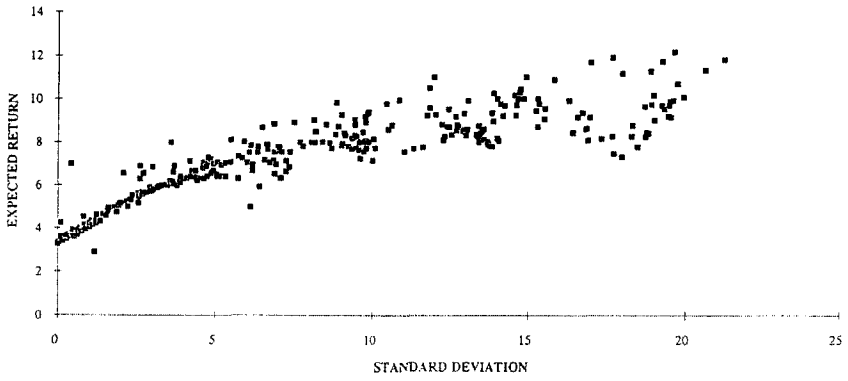


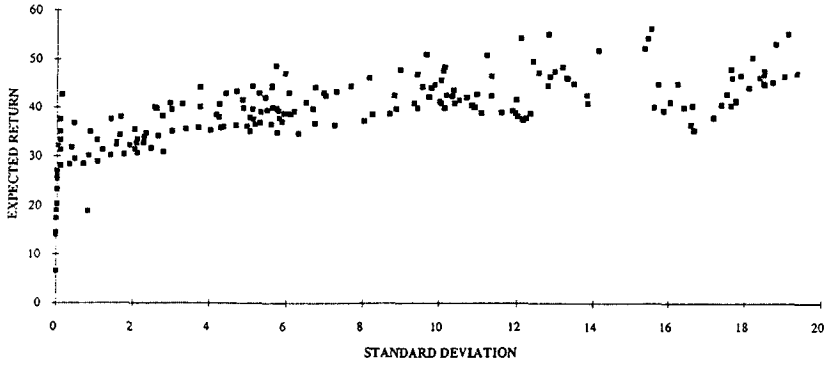
CHART 6
Return Frontier Generated with Arbitrage-Free Rate Modeling and a Normal Distribution (Base Case = Today's Curve, One-Year Horizon)



This is a return frontier (Chart 7), not an efficient return frontier because we didn't go all the way and compute each optimal portfolio for a given level of risk. Such portfolios would provide the highest return for the given amount of risk. Furthermore, these are expected returns in the future, not historical returns. This is similar to a capital asset pricing model approach in which you estimate a return frontier, evaluate the opportunities, and systematically select opportunities and allocate assets using the risk-free rate as kind of a benchmark or a guideline. We've developed what was called by Bob Lally from Metropolitan Life in the paper that he wrote for one of our conferences "a needs-driven approach to indexation." We develop the return frontier by taking a broad aggregate index, like the Shearson Leahman index, or the Merrill Lynch index, an index that will reflect the return opportunities that are available in total for fixed-income management. Then we eliminate the sectors that are not eligible investments because of investment committee decisions, and then we solve for the portfolio that has a minimum difference from the index and, at the same time, has performance characteristics of the liabilities. This slides the whole frontier in (down) further. If you put together the previous charts that I showed you, where the longer your investment horizon the flatter the frontier, with this approach, together with Jeff's presentation where he showed you the frontier for the pension funds versus the frontier for an insurance company, you can see that the solutions are similar. You would eliminate certain kinds of opportunities for investments, so your returns will be lower for the same risk. And what this becomes is like a custom bond index and, actually, it serves the same purpose as the ultimate risky portfolio, and then it becomes a benchmark for investment return from which you can make asset allocations and bets on the market. Furthermore, it gives the investment managers something that they can shoot for and allows you to analyze your assets and your liabilities both in the same context. We've developed a multiple duration context for managing the assets where we started, with the risk-free rate, which is defined by a horizon, and then used key-rate durations, which are durations or sensitivities to interest rates along the curve. Then we calculated the change in option-adjusted

spread and the implied volatility that takes into consideration the change in your assets for a given change in volatility when you have implied options or imbedded options in your assets or your liabilities.

CHART 7
Return Frontier — 5-Year Horizon Base Case Scenario Equals the Current Yield Curve



Now you can analyze your index in efficient frontier, and it gives you the characteristics of the index. The index, since it's closely matched to the performance of your liabilities, gives the investment managers a target that they can shoot for and follow in their own terms. This allows them to keep their eye on the ball without having to wait for reports from the asset/liability area or the liability area telling them exactly how the liabilities are performing. And the second advantage of custom bond indexation is that in managing this portfolio within a multiasset portfolio you can use scenario analysis to estimate the expected return and variance for the portfolio. With the expected return and variance of this portfolio, you can optimize for your total asset allocation decision across the company.

So, in summary, custom indexes provide a framework for risk and return and a guide for asset allocation framework in which investment managers have a target that they understand and the investment committee has a useful yardstick for measuring return and determining whether or not the investment managers are taking the risks specified by the investment committee. And, finally, you have a tool for integrating the fixed-income portfolio into the risk-management systems for a capital asset pricing model approach to the total company.

MR. FRANK S. IRISH: I think most of the people in the audience, if they step up at all, are going to step up with a certain diffidence in front of all of this technical competence. But I have a couple of questions particularly for Mr. Margolis. These are things that have always bothered me about the capital asset pricing model as applied in my field and perhaps some of the things I'm saying were reflected by Mr. Budinger. First of all, I think, Mr. Margolis, that you were calculating your total returns in a market-value sense, including market valuing the liabilities.

MR. MARGOLIS: That's right.

MR. IRISH: And that, of course, isn't appropriate in our business until Mr. Breeden has his way. Mr. Buff and I have had many discussions on this. Until Mr. Breeden has his way, we're going to live in a book-value world, and we're going to be judged by our results in a book-value world. So I think we have to talk about book-value results to some extent as being appropriate in our insurance world. Second, you spoke of the risk as being related to the variance, and in insurance we know that the true risk is worrying about what happens out at the 99th percentile. If your distribution is Gaussian, that's fine. What happens at the variance is proportional to what happens at the 99th percentile. But I strongly suspect the distributions that we worry about are not Gaussian and that the pattern of risk out at the 99th percentile is a very much different ratio to the variance. That's the risk we worry about, and that's the risk on which we have to make a rate of return. And this is somewhat related to Mr. Budinger's comment about the risk-based capital, because that's part of our life now and the year-to-year variance of results is by no means as important to us as the risk-based capital, which might be a different thing altogether.

MR. MARGOLIS: I guess I would answer your two comments together because I think they basically focus on what I think my comments were in terms of focusing purely on market value of results without regard in my discussion for some of the other constraints that insurance companies are under and really not focusing on the book value, nor the ultimate risk that risk-based capital looks at, or some of those other factors, and I would agree with you. In my comments I didn't talk about that, and the only reason I didn't talk about it was really a question of time. In terms of making decisions, we take into account all those constraints before we make decisions. I would differ with you with one point. I think you started out by saying that market value is really not what we should focus on but rather book value. I think that market value should be the objective function, and book value should be the constraint. And the reason I say that is that, if market value isn't important, then essentially asset/liability management is irrelevant. If only book value is important, then it really doesn't matter how interest rates change the value of the portfolio or the discounted value of the liabilities. So my view is that what really matters is the economic value of the company, but certainly book value, risk-based capital, and other constraints that are brought to bear on both life and property/casualty companies are critical to take into account, and we do that.

MR. BUFF: I'll throw in something in counterpart to what Jeff said. I'm not sure I agree that asset/liability management becomes irrelevant if everything is on a book-value basis. Certainly it's different and the considerations are different, but asset/liability processes that have to do with changing interest rates certainly do show up, some right away and some eventually within book-value reporting. And you can make a case that over long periods of time the behavior of book value, releases of earnings, growth, and surplus do pertain to the economic value, so they're somewhat related to market value. And, finally, it seems that you could do some interesting analyses looking at the projected present values of book-value earnings and view them as a kind of the market-value thing. You could think of the insurance company two ways. One is it's a portfolio of positive and negative assets like Jeff was mentioning, assets/liabilities, liabilities as negative assets, or you could view it as a security of some art form on its own where the coupon is the distributable earnings,

which in the U.S. for statutory purposes they are very much a book-value thing. And then you can look at analyses of the trends in those earnings, and asset/liability management becomes very important in that context. So it's not really again to disagree, but just to say that in a different context I think the whole asset/liability management does have some real applications there.

MR. MARGOLIS: I agree. I overstated the case by saying that asset/liability management is irrelevant in a book-value context, because ultimately book value and market value should come together, and therefore, it really becomes a timing issue rather than a difference issue. The other thing that just came to mind is that it seems that with the new FASB that book value and market value will be coming together over time anyway especially on the asset side of the balance sheet. What really bothers me about the FASB is that it is looking at only one side of the balance sheet, and what I've conjectured is that, for some companies, particularly companies that have long-tail liabilities, there may be an incentive to asset/liability mismatch on the short side by being short with their assets, and thereby, inadvertently, this new rule could incur more risk from an asset/liability context for some companies. But it's interesting to watch the proceedings anyway.

MR. BUDINGER: I have one thing to add. Actually the one experience I had with the regulators was because the firm did pay attention to book-value accounting more than market-value accounting and eventually the book value of the firm did come in line with the market value, which was assets eventually about 10% below what the liabilities were. And I think that this is a case where book-value accounting was not useful. I'm not saying it's useless, but market-value accounting would have been very, very useful in this situation. If they would have paid attention to market-value accounting sooner, they probably could have taken some action in order to avoid being taken over by the FDIC, FSLIC.