ASSET ALLOCATION STUDY
for

Contra Costa County Employees' Retirement Association

2011

June 6, 2011

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TABLE OF CONTENTS

Contra Costa County Employees' Retirement Association

Asset Allocation Study
June 6, 2011

SUMMARY

Milliman, Inc. has conducted this analysis for Contra Costa County Employees' Retirement Association. We conducted our last such analysis in early 2008. We believe the asset allocation study should be conducted every three to five years. Asset allocation is one of the most important investment decisions made by institutional investors. A study by Ibbotson and Kaplan (2000) found that, on average, nearly all of the variation in individual pension funds' performance was attributable to differences in their asset allocation.

This asset allocation study presents a number of alternative asset mixes for CCCERA's consideration that have been developed based on our estimates of asset class returns and risks. We present several mixes that could be appropriate depending on Board risk tolerance. This report does not address the allocations to sub-categories within most asset classes; these will be addressed separately when we consider implementation procedures.

As discussed at the Board meeting in January 2011, we have modeled the asset classes to incorporate a broad inflation hedging asset category for this study. The inflation hedge is an equal weighted blend of three indices: timber, commodities and inflation-linked bonds (TIPS). The custom inflation hedge asset class has a correlation of 0.46 with the CPI Index.

We find that the current mix is quite efficient, and continues to be a reasonable choice in that it – for all practical purposes – delivers nearly the maximum return that can be attained given the risk taken. The current mix delivers an expected rate of return of 7.75%. Our model delivers slightly different preferred combinations of assets for the same expected returns, but the benefits of moving are modest.

We assume that the Board would prefer to adopt an asset mix with an expected return of at least 7.75% in order to meet the actuarial interest rate assumption. We have proposed target asset mixes that are expected to deliver this rate of return, net of fees. We recommend Mix 7 (as profiled on page 5) as the new proposed target mix, which offers nearly the same expected return as the current asset mix, but with a reduced level of overall risk compared to the plan liabilities. We also present Mixes 6 and 8 as reasonable alternatives.

The Model

Our proprietary model integrates the liabilities into the asset allocation process, considering volatility of assets in combination with liabilities - Total Plan Risk - as well as standard deviations of asset returns alone. The model solves for asset mixes that provide the lowest possible Total Plan Risk for a given return. The use of the concept of Total Plan Risk results in asset mixes that best fund – and therefore move with – the Plan's liabilities.

To illustrate, an optimization based only on asset returns without consideration of liabilities would select a portfolio of 100% T-bills as the lowest risk portfolio, but T-bills are not the lowest Total Plan risk mix due to the duration mismatch between T-bills and the liabilities. (The present value of the liabilities, due to their long duration, changes dramatically with changes in interest rates, while the present value of T-bills does not, due to their short duration.) A portfolio comprised mostly of bonds with a similar duration to the liabilities - and therefore a similar sensitivity to changes in interest rates - would be a better match to the present value of the liabilities. (A dedicated portfolio of bonds with a duration matching the Liability duration of 13.4 years would result in a very low Total Plan Risk.)

The Inputs to the Model

Milliman has projected standard deviations, returns and correlations for a number of asset classes as well as the liabilities. Our projections are based on historical data, Milliman research, projections by outside sources and judgment. We evaluate the inputs as a whole to ensure their reasonableness as a set. We look at the risk-return characteristics of each asset class relative to the other asset classes as a check on our inputs and our view of the relative attractiveness of the asset classes.

To develop appropriate risks and correlations for the liabilities, we considered the Plan's projected benefit obligations for active and retired Plan members as provided by the Plan's actuary. We calculated the duration of these projected benefit payment streams. The longer the duration, the more sensitive the liabilities are to changes in interest rates. We also assessed the sensitivity of the Plan's liabilities to changes in inflation and real interest rates. Based on this analysis, we are able to predict how the liabilities will react to various changes in economic conditions. We then project the standard deviation and correlation of the liabilities with each of the proposed asset classes.

We should note that the actuarial interest rate includes 3.50% inflation component, while our estimated returns include inflation of around 2.75%.

The Output

Using our optimization program, we generated an "efficient frontier" of asset mixes. Each asset mix is optimal on a risk/reward basis, meaning that the highest expected return is achieved for any given level of risk. The asset mixes range from a low risk/low expected return mix to a high risk/high expected return mix. The lowest risk mix has the lowest funding variability due to the high correlation with the liabilities. The highest risk mix has the highest expected return but also has the greatest uncertainty in return variance and liability funding.

Selecting an Appropriate Optimal Asset Mix

All of the asset mixes on the efficient frontier are optimal for their particular level of risk. Other possible asset class combinations are so close to the frontier as to be essentially equivalent, and would also be suitable. The willingness and ability of CCCERA to take risks and the implications of possible mixes' funding status are the important factors in selecting the appropriate optimal asset mix. To assist in this decision, we present the sensitivity of the Plan's funded status to capital market returns. For each asset mix on the "efficient frontier," we consider the implications for achieving desired rates of return over short-term (1 year), medium-term (5 years) and a long-term (13.4 years - the liability duration) time horizons. Specifically, we focus on the following two questions:

1) What future returns, in dollar levels, are likely to be achieved by each mix, and how uncertain is that level?

2) What is the likelihood that the actuarially-assumed rate of return will be achieved for each mix?

In addition to CCCERA's willingness and ability to take risks and the implications for achieving required returns, adopting a new asset allocation target requires taking into account the Fund's current asset allocation and the costs to change. The expected cost of implementing a new asset mix must be considered relative to the expected benefit of the mix.

With the above considerations, a "Recommended" mix is suggested to facilitate the Board's selection of an appropriate optimal asset mix.

Asset Allocation and Plan Funding Uncertainty

Changes in economic conditions, especially inflation and interest rates, directly affect the costs of funding the Plan's liabilities. Asset allocation is effective if it provides an asset mix which generates reasonable returns for the Plan, while at the same time guards against high levels of funding uncertainty. In particular, an appropriate asset mix should guard against significant increases in liabilities that are unmatched by increases in assets. Two scenarios help illustrate this point.

1) A major concern is a *decrease* in the level of inflation. If a decrease in inflation is not accompanied by an increase in inflation-adjusted returns from the Plan's investments, an increase in contributions would likely be required.[1] Partial protection against this outcome is provided by an asset mix with allocations to longer-term bonds and equities. Long-term bonds, common stocks and other interest rate sensitive assets will

[1] A lower inflation rate decreases the nominal value of future benefit payments due to lower salary growth. However, assuming the assets' real rate of return remains unchanged, assets can be expected to grow at a commensurately slower rate. As a result, the discount rate will be lower. The result is an increase in present value of liabilities which typically more than offsets the effect of lower nominal payments.

typically have relatively superior returns during periods of falling inflation rates, thereby providing protection against an asset liability mismatch and lowering total plan funding volatility. Other asset classes such as cash equivalents and short-term fixed income securities do not provide such protection.

2) In the case of *rising* inflation and higher interest rates, the present value of the Plan's projected benefit payments will decline, and contribution rates could be lowered, assuming benefit payments are discounted at a higher rate and salaries and cost of living adjustments are not increased for higher inflation. Thus, a decline in the principal (market) value of longer-term assets may be acceptable under such circumstances. Of course, it is preferable to avoid this if possible. Real assets, such as real estate, TIPS and other non-financial assets, can provide some protection from unanticipated inflation.

It is desirable to have an asset mix that can effectively cope with different economic environments and varying levels of inflation. Our asset allocation model incorporates plan liabilities to provide the lowest possible total plan risk (variation of the difference between assets and liabilities) for a given return. The inclusion of Plan liabilities in the analysis results in asset mixes which better fund the Plan's liabilities and maintain a competitive rate of return.

Changes from 2008 Study

The first section of this *Asset Allocation Study* discusses various changes in methodologies and capital market assumptions between the prior (June, 2008) study and this current study. A number of changes have been included in the current study that we feel incrementally improve the study's results.

Liability Analysis

The second section of this *Asset Allocation Study* is an analysis of the Plan's liabilities. In addition to calculating the present value of the Plan's liabilities, we consider the timing of the liabilities and calculate a duration for the liabilities. Finally, we investigate how the value of the liabilities will vary based on key assumptions, the most important of which is the inflation rate.

The projected benefit payments used in this study are provided by the Plan's actuary, The Segal Company. The actuary provided annual benefit payment projections covering the next 100 years (our charts display only the first 50 years as the discounted values become insignificant after this time). All the payment projections take into account the Plan's liability characteristics, including membership demographics, salary statistics, benefit payments, years of service and actuarial membership survival assumptions. Finally, the actuary provided similar liability projections under an alternative inflation scenario.

Asset Allocation Alternatives

The third section of the *Study* describes the expected returns, volatility, and relationships between the different asset classes in which the Plan currently invests as well as new asset classes. The outcome of this research combined with the liability analysis is an efficient frontier of asset mixes, a set of asset mixes which provide the highest expected return for a given level of plan funding uncertainty. These mixes range from a low-return/low-uncertainty mix to a high-return/ high-uncertainty mix. The optimality of these mixes is based on the assumption that the Plan's investment managers are capable of delivering the expected risks and returns of their respective asset classes, and that the relationships (correlations) between these asset classes do not significantly change over the next ten years. Once we determined the initial efficient frontier, we expanded the number of alternative mixes shown in the range which is most appropriate for the Plan, given the return objectives, risk tolerance and current asset mix of the Plan.

Conclusion

A case could be made why the Association might wish to adopt any of the proposed asset mixes. Mix 7 is expected to deliver an expected 7.75% rate of return over the next 10 years. Mixes 6 and 8 are also reasonable alternatives. We recommend adoption of Mix 7, which is expected to deliver the actuarial interest rate of 7.75% at a standard deviation of 13.26%. We would also encourage the Board to give serious consideration to Mix 8, which has a slightly higher expected return.

We conclude that the current asset mix is nearly optimal in terms of return for the risk taken. We propose the adoption of Mix 7, which is within range of the current target asset allocation. Moving to Mix 7 would reduce the global equity allocation by 8.0%, decrease overall fixed income by 1.0% (shifting 3.0% out of global fixed income while adding 2% to high yield). The real estate allocation would be increased by 1.0% and the allocation to alternative investment would rise by 3%. An inflation hedge would be introduced at a 5% allocation. The cash allocation would be unchanged as would the (unfunded) allocation to long bonds. The Current Target and Proposed Asset Mixes are detailed below.

Component	Current Target	Alternative Mix 6	Recommended Mix 7	Alternative Mix 8	Proposed Ranges of Mix 7
Global Equities	49.0	39.2	41.0	42.6	37-45%
Global Fixed	24.0	22.8	21.0	19.4	17-25%
High Yield	3.0	5.0	5.0	5.0	2-9%
Long Bonds	5.0	5.0	5.0	5.0	2-9%
Real Estate	11.5	12.5	12.5	12.5	9-15%
Alternatives	7.0	10.0	10.0	10.0	5-12%
Inflation Hedge	0.0	5.0	5.0	5.0	0-10%
Cash	0.5	0.5	0.5	0.5	0-1%
Return, %/yr	7.75	7.65	7.75	7.85	
Standard Deviation, %/yr	13.69	12.94	13.26	13.57	
Total Plan Risk, %/yr	18.19	17.79	18.05	18.31	

CHANGES FROM 2008 STUDY

Enhanced Liability Measurement

In all prior studies, we have measured the duration of the projected liabilities by discounting the actuary's projected benefit payments back to the present using the actuary's discount rate of 7.75%. When measuring the liability's correlation to the asset classes under consideration, we made the assumption that the liabilities would behave similar to a bond of equal duration. For example, if the liabilities had a duration of 10 years, we assumed the liability's correlation to the S&P 500 would mimic that of the 10-year constant duration bond's correlation with the S&P 500. This was, and remains, a reasonable assumption. However, we have revised the process for estimating the liability correlations by using the Citigroup Pension Discount Curve and Liability Index.

The Citigroup Pension Discount Curve tracks the yield of a basket of AA-rated bonds on a monthly basis. The bonds are divided into one-year categories according to their final maturity. By looking at the segment of the curve that mirrors the duration of the Contra Costa County Employees' Retirement Association liabilities (13.4 years), we can see how a bond of similar duration has behaved over the past 10 plus years on a monthly basis and we can measure the correlation of this segment of the discount curve with the asset classes under consideration. This is a more accurate and detailed measurement process than used in prior studies.

We then measured how the projected Contra Costa liabilities *would have responded* to the markets over the last 10 plus years based upon their duration and the corresponding Citigroup Pension Discount Curve maturity category. We used this information to construct a hypothetical return stream for the liabilities. Once we had this return stream, we measured its correlation with the asset classes under consideration through March 31, 2011.

We noted that when using our new methodology, the correlation of the Contra Costa liabilities to all asset classes fell considerably from the values in our prior study, with the exception of the fixed income correlation. Much of this change was specific to the events of late 2008 where the liabilities spiked up when most other asset classes fell considerably.

LIABILITY ANALYSIS

Overview

Our analysis of the liabilities is based on projections provided by CCCERA's actuary, The Segal Company. Segal's projection of benefits to members incorporates numerous assumptions regarding future salaries, mortality rates, termination rates, disability rates, inflation, etc. Inflation is projected at 3.50% per year by the actuary, while earnings on assets (used to discount future liabilities) is projected at 7.75% per year.

At our request, Segal projected the payments to be made to retired, inactive and current Association members related to current service and anticipated future wage growth. Benefits for future service were not considered in these liability projections, since they will be funded with future contributions invested in future assets. Keeping our focus on present members' benefits correctly matches our focus on the present assets. This does not limit the value of this study; future studies will most likely find similar member demographics and reach similar conclusions.

We estimate the volatility of the liabilities and their correlation with each of the proposed asset classes. Appropriate estimates of these variables allow us to determine asset mixes that best fund the Plan's liabilities. Total Plan Risk can be reduced by selecting assets that behave like the liabilities through fluctuations in financial markets and therefore offset the liabilities volatility.

For the baseline projection case, we have used an inflation rate of 3.50% per year, and a real return of 4.25% per year, resulting in a discount rate of 7.75%. The real return assumption of 4.25% used in our discount rate represents the expected return above inflation for a moderate-risk asset.

Analysis of Retired and Inactive System Members

Our liability analysis begins with a review of the retired and inactive (terminated vested) Association members. All promised benefits payable to this group have been accrued, so projected benefits are quite predictable.

We calculate the present value of projected benefits to retired and inactive members to be $3,801.1 million, after discounting the benefits at a 7.75% annual rate.

Figure 1 below shows graphically the benefit payment projections for retired and inactive members. Actual benefits paid to current retirees increase over the next few years due to inflation, and then decline due to mortality while nominal benefits paid to inactive members peak 30 years in the future.

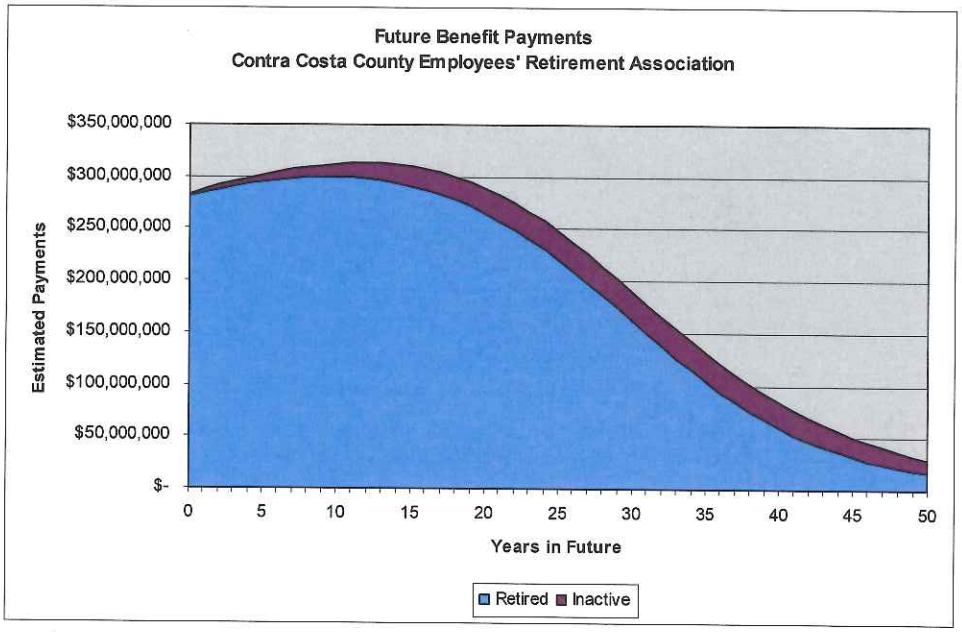

Figure 1

Discounted benefits for retired and inactive members – the present value of benefits (shown in Figure 2, below) – decline immediately at an average rate of 11.4% per year, as the 7.75% discount rate and mortality assumptions decrease the present value of benefits, and will have fallen to half their value in roughly ten years. Some 40 years into the future, the discounted benefits to current retirees and inactive members are relatively insignificant. The average benefit is paid 10.1 years in the future.[2] This gives an indication of the sensitivity of the present value of these liabilities to changes in interest rates.

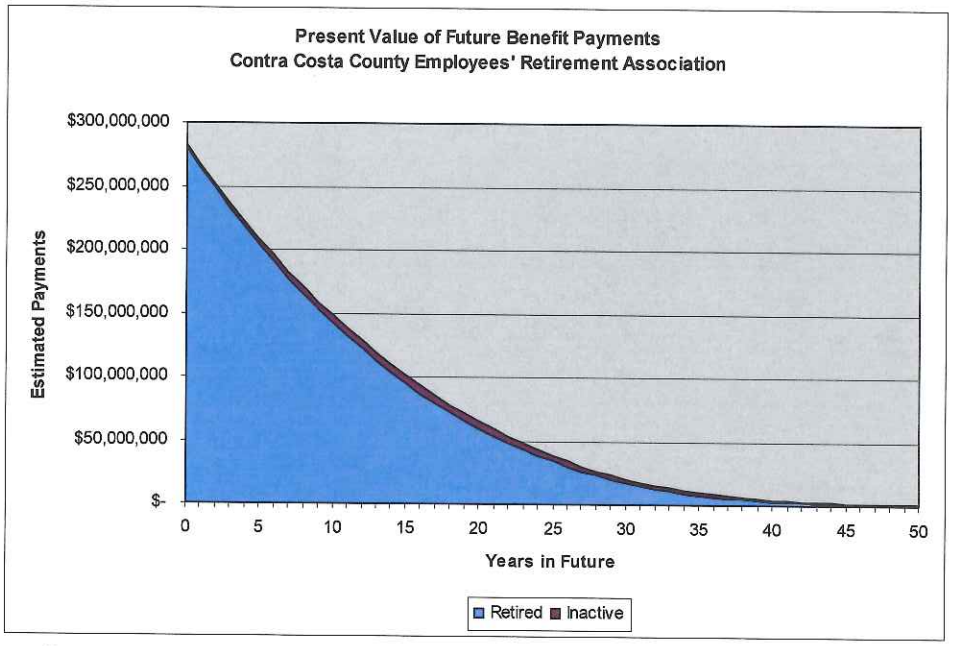

Figure 2

We have investigated the impact of a higher inflation rate of 4.50% instead of the 3.50% baseline assumption. We held the real return constant at 4.25%, so the discount rate increased from 7.75% to 8.75% in this sensitivity test. Increasing the inflation rate by 1.00% causes the present value of the retired and inactive members' liabilities to decrease 8.27% to $3,486.8 million.

We also investigated the impact of a higher real rate of return: increasing this rate decreases the cost of funding future payments by increasing the discount rate. By increasing the projected real rate of return from 4.25% to 5.25% per year, the discount rate rises to 8.75%. While actual payments to retirees are unchanged, this causes the present value of benefits to fall by 8.59% to $3,474.5 million, nearly the same effect as a 1.00% change in the inflation assumption since the cash flows to the retired and inactive members are largely determined.

[2] In computing the average payment, we weight discounted payments by the number of years in the future. This is identical to the computation of a Macaulay bond duration.

Analysis of Active System Members

In contrast to retired member benefits, active members will earn a large portion of their projected benefits in the future. These future benefits can be broken down into three components:

1. Accrued service only
2. Future wage inflation
3. Future real wage growth

In the analysis below, we treat projected payments related to future service separate from wage inflation and real wage growth, which will be examined in the final analysis.

Figure 3 below shows the additional benefit payments attributable to accrued service. Benefits for accrued service build for a number of years and peak 28 years in the future. Adding these benefits greatly increases the overall future benefit payments, but the bulk of these payments are made farther into the future. The impact of the discounted cash flows is outlined on the following page.

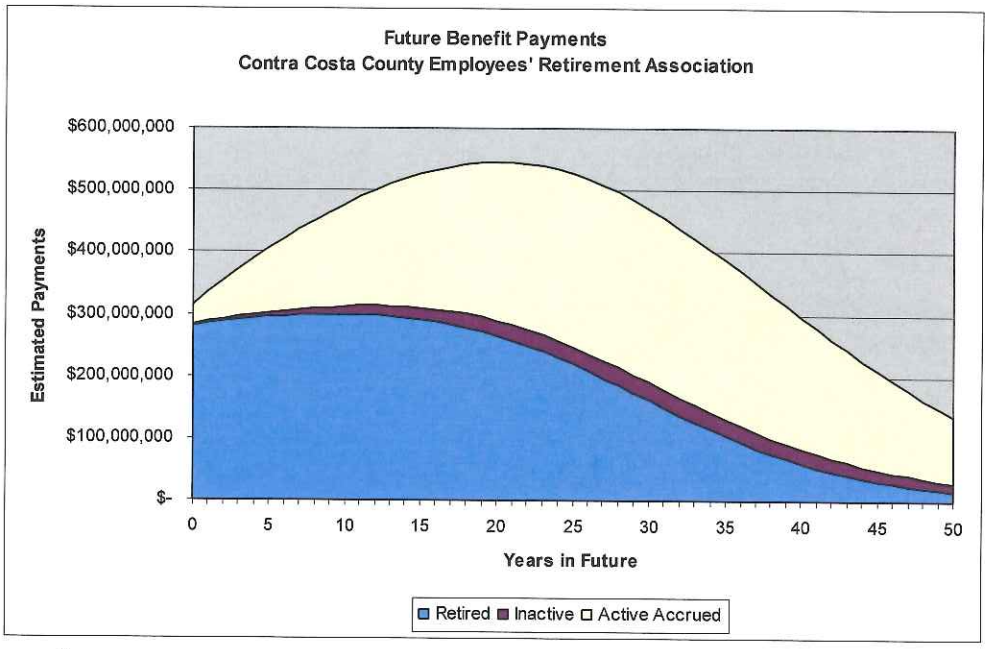

Figure 3

As with current retirees, discounting active members' liabilities shifts the impact of the distribution towards the present and reduces it substantially, since payments far in the future have a much lower present value than future value. The peak in discounted liabilities occurs 9 years in the future and these liabilities become insignificant 50 years in the future (see Figure 4 below). The present value of the estimated benefits to active members for accrued service is $2,073.5 million and the average payment (duration) occurs 16.60 years in the future.

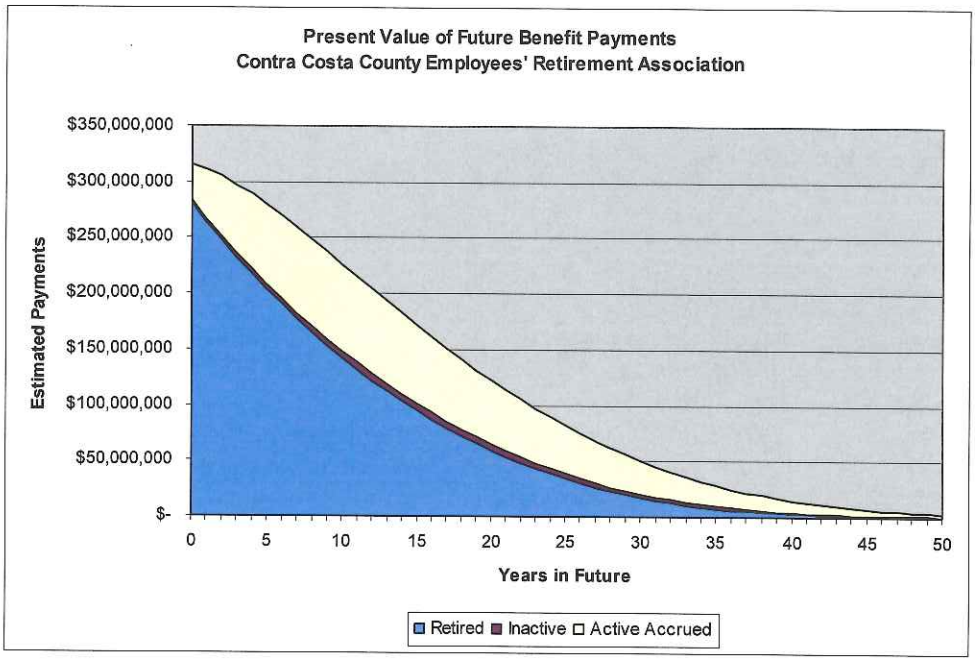

Figure 4

As we did for retired and inactive members, we prepared a sensitivity analysis for active members considering changes in inflation and the real rate of return. We increased the inflation assumption by 1.00%, from 3.50% to 4.50%. Higher inflation increases final salaries – and therefore, benefits – due to the higher salary growth over many years. However, to maintain a constant "real" rate of return the discount rate is also increased, which decreases the present value of the benefits. Our higher-inflation scenario resulted in a present value of $1,796.99 million, 13.34% lower than the baseline assumption. The increases resulting from higher inflation are more than offset by the decreases resulting from the higher discount rate, so the benefits become less expensive to fund.

Changes in real returns have a somewhat greater impact than changes in the inflation rate: if we increase the assumed real rate of return from 4.25% to 5.25% while maintaining our 3.50% inflation assumption, the liabilities' present value decreases 13.78% to $1,787.68 million. Because inflation is constant instead of increasing, future salaries are not higher; while the discount rate increases due to the change in the real rate of return.

Analysis of All Members — Retired, Inactive, Active and Future Growth

Figure 5 below shows the combined nominal benefit payments attributable to retired, inactive, and active members. The active member liabilities shown below layer the projected benefits attributable to wage inflation (shown in light blue in Figure 5) and wage growth (shown in purple) on to the accrued benefits examined earlier. Benefit payments from all sources attributable to active employees build for a number of years and peak 24 years in the future. Adding these projected benefit payments to those attributable to retired and inactive employees increases the overall future benefit payments and pushes them farther into the future. The impact of the discounted cash flows is outlined on the following page.

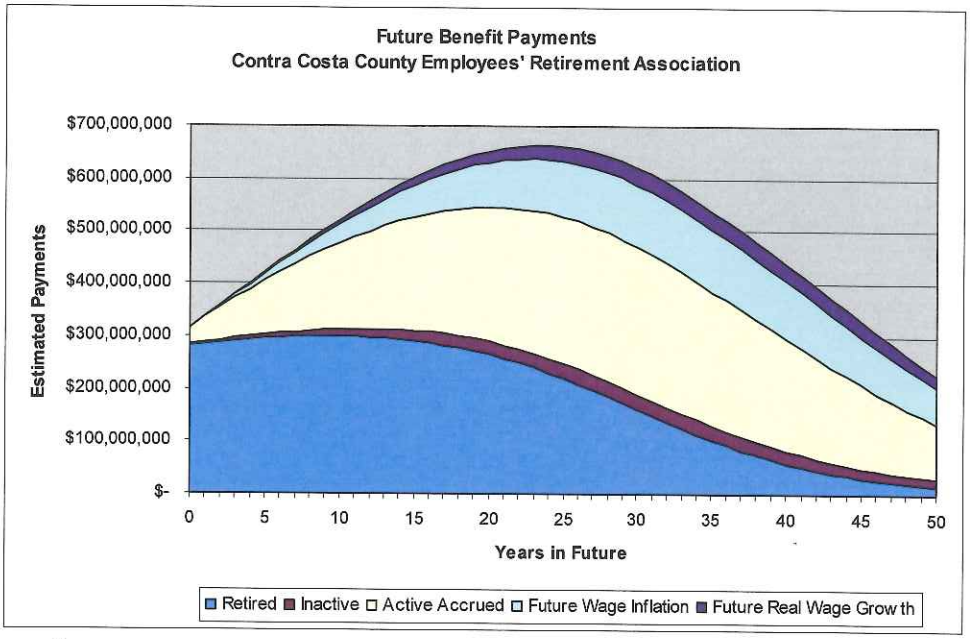

Figure 5

The peak in discounted liabilities for all active employees' service occurs 11 years in the future and these liabilities become insignificant 50 years in the future (please see Figure 6 below). The present value of the estimated benefits to all active members is $2,792.0 million and the average payment (duration) is 18.01 years in the future.

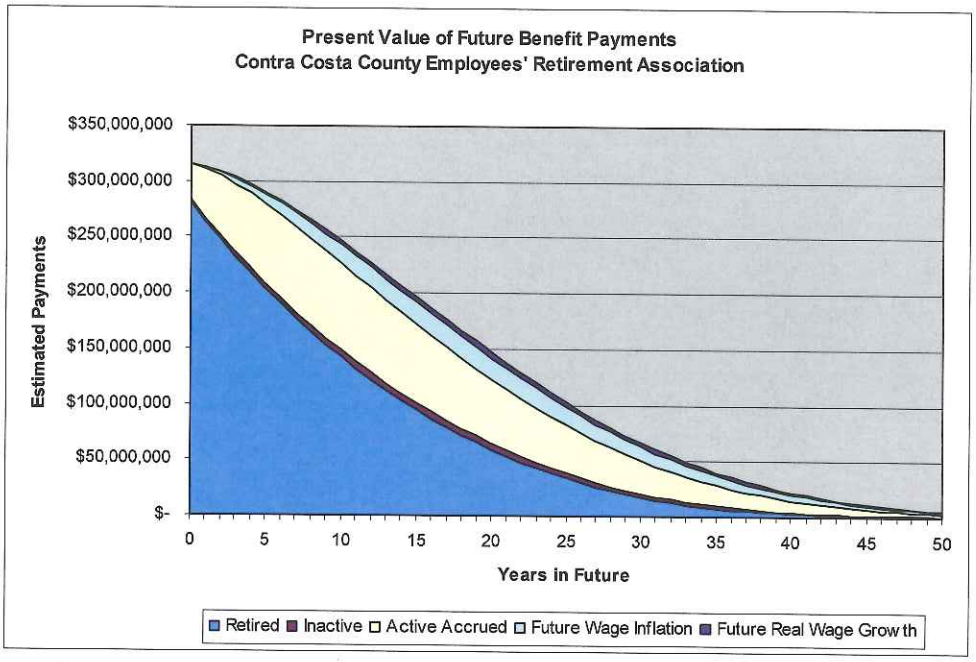

Figure 6

As stated previously, the long duration of the Plan's liabilities makes them highly sensitive to changes in the inflation rate and real rate of return. Absent a change in expected real returns, a 1.00% increase in the inflation assumption decreases the present value of liabilities to $6,031.63 million, an 8.52% decrease. Increasing the real return assumption from 4.25% to 5.25% without an offsetting change in inflation decreases the present value of liabilities by 11.25% to $5,851.51 million.

Analysis of All Members - Retired, Inactive, Active and Future Growth

Including all the components of active member liabilities (accrued service, future wage inflation and future real wage growth) with the total liabilities gives the projections a stronger forward-looking perspective. By combining the projected payments to retired and inactive members with the projected payments to active members for accrued and future service, future wage inflation and future real wage growth, all members' benefits have an estimated present value of $6,593 million (discounted by the 7.75% baseline assumption), with a duration of 13.4 years. This compares to an estimated $5,370 million present value and 13.9 year duration in the 2008 study.

Member	Present Value	Duration (Years)
Current Retirees	$3,625.53 mm	9.66
Inactive Members	$175.55 mm	18.63
Active (Accrued)	$2,073.50 mm	16.60
Active (Inflation)	$574.90 mm	21.76
Active (Growth)	$143.64 mm	23.24
Total	$6,593.12 mm	13.43

Comparison to Prior Studies

Liabilities	Retired and Inactive Members		Active Members		Combined Members	
	Present Value	Duration	Present Value	Duration	Present Value	Duration
1997	$890 mm	9.7	$787 mm	18.9	$1,677 mm	14.0
2000	$1,231 mm	10.0	$1,162 mm	19.2	$2,393 mm	14.4
2005	$2,212 mm	9.7	$2,044 mm	19.2	$4,256 mm	14.3
2008	$3,020 mm	10.1	$2,350 mm	18.8	$5,370 mm	13.9
2011	$3,801 mm	10.1	$2,792 mm	18.0	$6,593 mm	13.4

Funding Ratio Implications

In our analysis, we consider the funding ratio – the value of the liabilities relative to the assets. When liabilities are larger than assets, the assets must move more than the liabilities in market value to maintain the same dollar funded status. For example, if liabilities are $100 and assets are $80 and the liabilities increase 10% to $110, the assets must increase 12.50% to $90 to maintain the same $20 under-funded status; the same is true for negative returns.

The Plan's assets as of December 31, 2010 were $5,049.36 million, less than the projected present value of the liabilities of $6,593.12 million. We adjusted the liability volatility estimate upward to reflect this ratio. Please note that this funding ratio is not the same as the one reported by the Association's actuary.

Liabilities Summary

We undertook a review of the Association's liabilities to consider the time-horizon of payments and the sensitivity of the liabilities to factors that can also cause asset values to vary.

Payments to all current members are expected to be paid on average 13.43 years into the future (on a discounted present value basis). These payments have characteristics similar to a long-term bond. This 13.43 year duration indicates that the value of the Plan's liabilities is exposed to substantial volatility from changes in the assumed discount rate: a 1.00% increase in inflation causes a decrease of 8.52% in the liabilities' present value, while a 1.00% increase in the real return causes a more substantial decrease of 11.25% in the value of the liabilities. A 1% increase in the discount rate would lead to a decrease of approximately 13.43% in the present value of the liabilities.

The liability characteristics developed in this section are used in the following section to develop the relationship of the liabilities with the asset classes.

ASSET ALLOCATION ALTERNATIVES

Introduction

If it were possible to create an asset mix that matched the liabilities there would be no uncertainty about funding – the Plan could project future funding ratios exactly, based on contribution levels. It is possible to build a dedicated bond portfolio that would fund projected benefit payments closely. We do not believe the Plan should pursue this "riskless" goal, for the following reasons:

- No asset or combination of assets match the sensitivity of Plan liabilities exactly because projected benefits are only estimates subject to revision. A bond portfolio with a 13.4 year duration would come closest to our low risk Mix 1, but using such a portfolio would concentrate the Plan in a small fraction of available investment-grade assets.

- By selecting assets such as equities or alternative assets that exhibit other patterns of return variability, the Plan may be able to get a much higher return from its assets. This may be preferred to a less volatile, lower-return mix.

- Liability matching is not the only goal of asset allocation. Absolute rates of return and performance compared to peers are also considerations. Very long duration bond portfolios exhibit high absolute volatility that could prove damaging to a fund in the short-term even though matching the liabilities.

For these reasons we use both the total bond market and long duration bonds in this study, but focus on the total bond market when discussing the opportunity set.

In this section we construct asset mixes that are optimal – the highest expected return for a given amount of uncertainty – while considering inflation and other sources of uncertainty. The lowest-risk mix most closely matches the characteristics of the liabilities and thus has the lowest Total Plan Risk; higher-return mixes show greater uncertainty.

Asset Categories

The asset/liability approach used in this analysis is best suited for comparing broad asset classes, while other approaches are more appropriate for fine-tuning classes (e.g., for allocating equities between large- and small-capitalization issues or allocating fixed income between mortgages and corporate issues).

In our approach, we include the global asset classes already in the CCCERA portfolio as well as adding a custom blend of three inflation hedging asset classes to create a blended asset class that functions as a diversified inflation hedge. The three asset classes include timber, commodities, and inflation-linked bonds. Each asset class was given an equal weight.

Commodities (and timber) have historically had a low, or negative, correlation to other asset classes and a high correlation to inflation. Commodity (and timber) prices tend to rise with inflation; hence, the asset class offers a source of protection from rising inflation. TIPS securities offer protection from inflation as the principal amount of TIPS securities is adjusted when inflation rises.

Should CCCERA wish to implement an inflation hedge into the portfolio, we will review and suggest a variety of public and private investments and will present alternatives in a subsequent study.

GLOBAL ASSET CLASSES

As discussed earlier, we conducted a study using global asset classes. To study the asset categories selected, we selected a representative index for each that both captures the characteristics of the category and is well-defined:

(1) Global Equities (MSCI All Country World Index (ACWI));
(2) Global Fixed Income (Barclays U.S. Aggregate Bond Index);
(3) High Yield Fixed Income (Merrill Lynch Master II High Yield Index);
(4) Long-Duration Fixed Income (Barclays Long Govt/Credit Index);
(5) Real Estate (FTSE EPRA/NAREIT Developed Index);
(6) Alternative Investments (UBS Private Equity Performance Indicator);
(7) Inflation Hedge (DJ UBS Commodities/ML U.S. TIPS/NCREIF Timber, equally weighted)
(8) Cash and Equivalents (91-day Treasury Bills); and
(9) Plan Liabilities as developed in the *Liability Analysis* section of this report, shown as a "negative asset" that other assets serve to offset.

Expected Returns and Uncertainty

Our model uses the expected annual return and the uncertainty of returns (standard deviation) for each asset class. Below are our projections for each asset class:

Asset Class	Annual Return	Std Dev
Global Equities	9.25%	19.55%
Global Fixed Income	3.60	4.45
High Yield Fixed Income	7.00	11.35
Long Duration Fixed Income	4.85	9.05
Real Estate	9.25	23.65
Alternative Investments	11.95	30.00
Inflation Hedge	5.40	8.00
Cash	3.00	1.15
Liabilities	n/a	14.45[3]

Derivation of the assets' estimates is described in the *Appendix A - Basis for Capital Market Assumptions*. The liabilities' uncertainty was derived from their characteristics, primarily, the sensitivity of benefit payments to changes in interest rates (duration).

The projections reflect our assessment of returns and risks over the next ten years, and we believe also approximate how investors in aggregate would expect these assets to perform.

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[3] $LiabilityVolatility = \left(\frac{LiabilityDuration}{BondMarketDuration}\right) \times \left(BondVolatility\right) \times \left(\frac{PlanLiabilities}{PlanAssets}\right)$

Correlations

The following "correlation matrix" indicates the extent to that we project an increase in the value of one asset class will match an increase in the value of another. For example, the 0.67 correlation between global equities and high yield shows that roughly 67% of increases or decreases in global equity returns correspond to similar moves in high yield securities.

	Global Equity	Global Fixed	High Yield	Long Bonds	Real Estate	Alter-natives	Inflation Hedge	Cash	Liabilities
Global Equity	****								
Global Fixed	-0.06	****							
High Yield	0.67	0.09	****						
Long Bonds	-0.02	0.93	0.07	****					
Real Estate	0.77	0.09	0.63	0.10	****				
Alternatives	0.76	-0.11	0.45	-0.05	0.53	****			
Inflation Hedge	0.02	-0.02	0.11	-0.05	0.10	0.15	****		
Cash	-0.07	0.21	-0.13	0.06	-0.14	0.15	0.13	****	
Liabilities	0.07	0.75	0.14	0.90	0.17	-0.06	-0.10	-0.04	****

The correlations used in this projection are close to their recent historical values as shown in *Appendix A – Basis for Capital Market Assumptions*. Correlations to the liabilities are derived by analyzing the sensitivities in the previous section.

Constraints

Some asset classes were constrained to limit consideration to reasonable mixes; this did not unduly restrict choices. Long-duration fixed income was constrained to 5% of assets; real estate was constrained to 12.5%; alternative investments were constrained to 10% of assets (to prevent a 100% alternative investment option as the highest return option) and the inflation-hedging category was constrained to 5%. Also, a minimum of 0.5% was specified for short term fixed income. Cash and equivalents are undesirable investments for a long-term liability stream, but some cash-on-hand is necessary in the course of operations. We advise reducing cash as much as possible.

Optimal Asset Mixes for Given Risk Levels - Broad Asset Mix, Global Asset Classes

Component	Limits min	Limits max	*I*	*II*	*III*	*IV*	*V*	***VI***	***VII***	***VIII***	*IX*	*X*	Target
			Asset Mix Alternatives										
Global Equity	12.0	100.0	12.0	12.0	14.9	20.7	26.2	**32.1**	**41.0**	**51.1**	61.2	89.5	49.0
Global Fixed	0.0	100.0	82.5	71.9	60.9	51.8	39.5	**30.7**	**21.0**	**10.9**	0.8	0.0	24.0
High Yield	0.0	5.0	0.0	1.1	5.0	5.0	5.0	**5.0**	**5.0**	**5.0**	5.0	0.0	3.0
Long Bonds	0.0	5.0	5.0	5.0	5.0	5.0	5.0	**5.0**	**5.0**	**5.0**	5.0	0.0	5.0
Real Estate	0.0	12.5	0.0	9.4	12.5	12.5	12.5	**12.5**	**12.5**	**12.5**	12.5	0.0	11.5
Alternatives	0.0	10.0	0.0	0.0	1.3	4.1	6.2	**9.1**	**10.0**	**10.0**	10.0	10.0	7.0
Inflation Hedge	0.0	5.0	0.0	0.0	0.0	0.0	5.0	**5.0**	**5.0**	**5.0**	5.0	0.0	0.0
Cash	0.5	0.5	0.5	0.5	0.5	0.5	0.5	**0.5**	**0.5**	**0.5**	0.5	0.5	0.5
Return, %/yr			4.33	4.90	5.47	6.04	6.61	**7.18**	**7.75**	**8.32**	8.89	9.46	7.74
Standard Deviation, %/yr			4.61	5.75	6.99	8.37	9.72	**11.42**	**13.26**	**15.17**	17.11	19.86	13.69
Total Plan Risk, %/yr			11.57	12.02	12.85	13.94	15.18	**16.56**	**18.05**	**19.65**	21.31	23.93	18.19

Mixes I–X in this table make up the range of optimal portfolio mixes excluding emerging markets, the "efficient frontier." (We use Roman Numerals to differentiate these mixes from the narrower set of mixes that follows.) Mixes VI, VII and VIII, shown in bold, will be the focus of analysis in the next section of the report. Each of the ten mixes offers the highest possible expected return given the limits for a given level of fund uncertainty – Total Plan Risk.

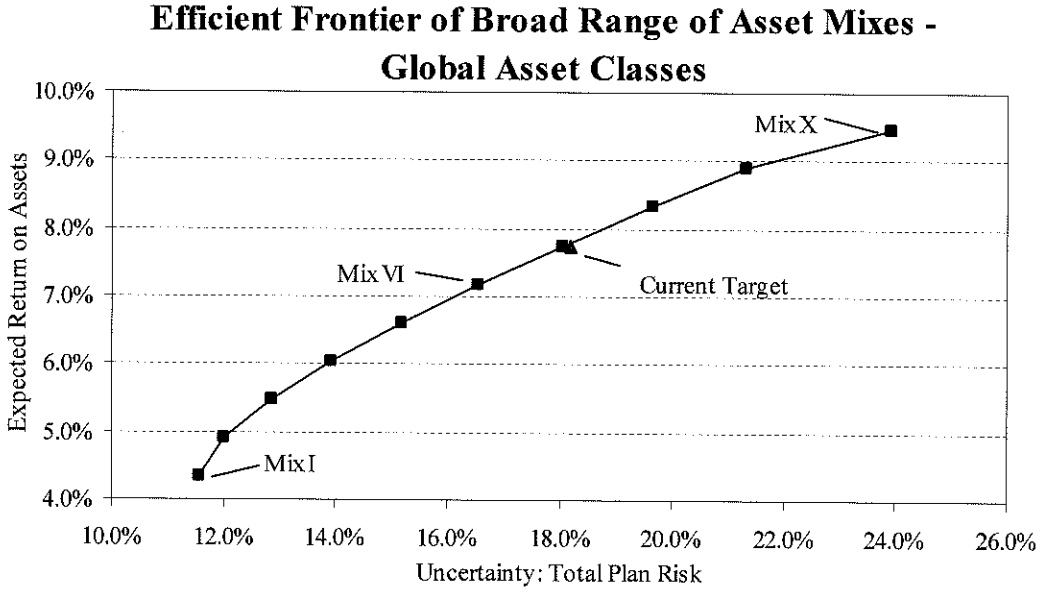


Figure 7

In Figure 7, the 10 "optimal" asset mixes are displayed on a risk/return graph, together with the current target. A reassuring finding of this analysis is that the current actual mix is essentially on the efficient frontier.

While the output of our model specifies ten optimal assets mixes, there are virtually an infinite number of efficient asset mixes. Between each risk-reward point in the above table there are many slightly different efficient risk/reward asset mix portfolios. Because the mixes I through V, and IX through X seem inappropriate, we derived additional efficient mixes within the range of mixes VI through VIII. The results are shown below:

Optimal Asset Mixes for Given Risk Levels:
Narrowed Risk/Reward Range

	Limits		*Asset Mix Alternatives*										
Component	min	max	*1*	*2*	*3*	*4*	*5*	***6***	*7*	***8***	*9*	*10*	Target
Global Equities	0.0	100.0	31.8	32.8	33.9	35.6	37.5	**39.2**	**41.0**	**42.6**	44.5	46.2	49.0
Global Fixed	0.0	100.0	31.3	29.7	28.1	26.4	24.5	**22.8**	**21.0**	**19.4**	17.5	15.8	24.0
High Yield	0.0	5.0	5.0	5.0	5.0	5.0	5.0	**5.0**	**5.0**	**5.0**	5.0	5.0	3.0
Long Bonds	0.0	5.0	5.0	5.0	5.0	5.0	5.0	**5.0**	**5.0**	**5.0**	5.0	5.0	5.0
Real Estate	0.0	12.5	12.5	12.5	12.5	12.5	12.5	**12.5**	**12.5**	**12.5**	12.5	12.5	11.5
Alternatives	0.0	10.0	8.9	9.5	10.0	10.0	10.0	**10.0**	**10.0**	**10.0**	10.0	10.0	7.0
Inflation Hedge	0.0	5.0	5.0	5.0	5.0	5.0	5.0	**5.0**	**5.0**	**5.0**	5.0	5.0	0.0
Cash	0.5	0.5	0.5	0.5	0.5	0.5	0.5	**0.5**	**0.5**	**0.5**	0.5	0.5	0.5
Return, %/yr			7.15	7.25	7.35	7.45	7.55	**7.65**	**7.75**	**7.85**	7.95	8.05	7.74
Standard Deviation, %/yr			11.32	11.63	11.94	12.26	12.61	**12.94**	**13.26**	**13.57**	13.93	14.24	13.69
Total Plan Risk, %/yr			16.47	16.73	16.99	17.24	17.52	**17.79**	**18.05**	**18.31**	18.61	18.86	18.19

In Figure 8 below, the 10 narrowed "optimal" asset mixes are displayed on a risk/ return graph, together with the current target. We will focus on Mixes 6, 7 and 8, as well as the current target in the next section of the report.

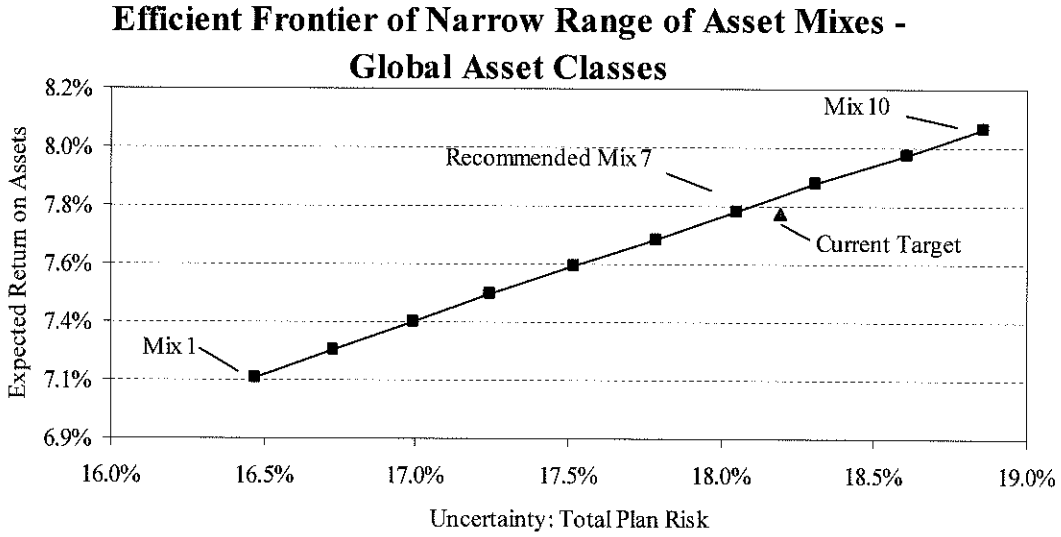


Figure 8

IMPLICATIONS FOR ACHIEVING THE ACTUARIAL INTEREST RATE

The prior section presented alternative asset mix choices. This section considers how the choice of one of those mixes will impact the Association's achievement of the actuarial interest rate.

Figure 8, shown on page 21, compared the annual expected return to the estimated funding uncertainty (net standard deviation) for the 10 narrowed efficient asset mixes. There are two questions that should be addressed at this time:

1) *What dollar level of future returns are likely to be achieved by each mix, and how uncertain is that level?*
2) *What is the likelihood that the actuarial-assumed rate of return (in this case the actuarial hurdle rate) will be achieved by each mix?*

Figure 9 portrays the expected return and range of returns for the narrowed asset mixes and the current target. Mix 1 has an expected return of 7.15% per year, with an asset risk level of ±11.3% percent per year. This mix has approximately a 48% chance of beating the 7.75% actuarial hurdle rate assumption over the next year. Mix 10 has an expected return of 8.05% per year, with an uncertainty of ±14.2%. This indicates approximately a 51% chance of exceeding the assumed 7.75% actuarial hurdle rate over the next year. Mix 7 has approximately a 50% chance of achieving a return greater than 7.75% over the next year.

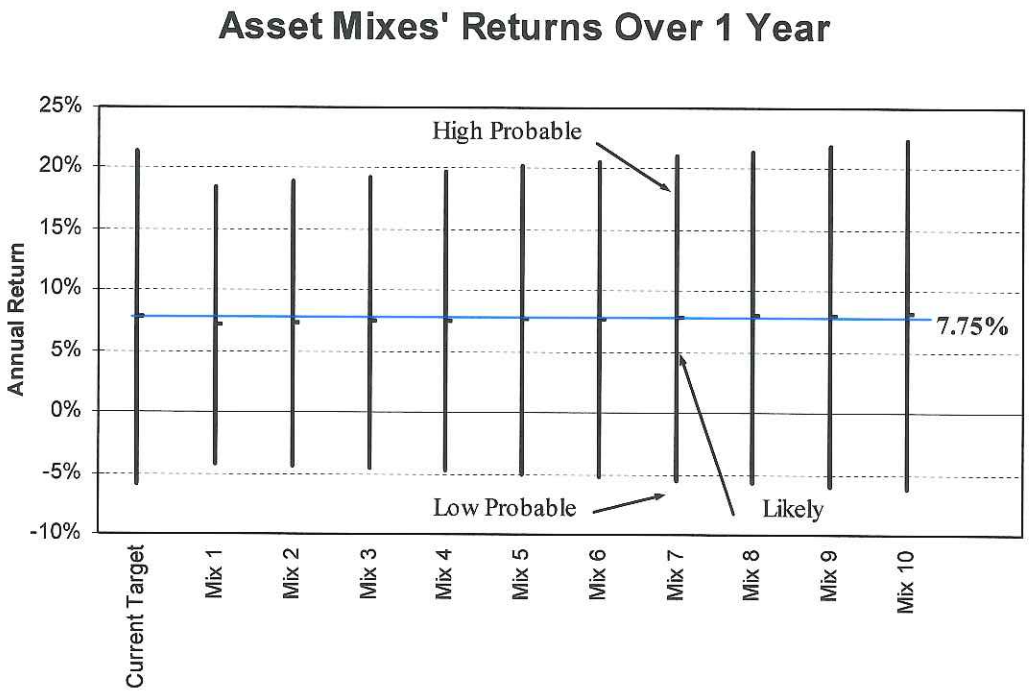


Figure 9

For each mix, there is a one-in-six (about 17%) chance the return will be higher than the "High Probable", and also a one-in-six chance of having a return lower than the "Low Probable" return.

Alternatively, the Retirement Association can consider the Asset Mixes in light of the extra dollars earned vs. the 7.75% actuarial-assumed hurdle rate of return. Figure 10 below displays this information for a one-year period. For Mix 1, the expected return would be below the $391.3 million anticipated if the actuarial rate of return was achieved on the current asset base, since it has an expected return of 7.15%, below the 7.75% actuarial interest rate. Its uncertainty range is the expected level plus or minus $571.6 million (11.3% of $5.0 billion, the market value of total assets at year-end). The "uncertainty range" is displayed on the graph as the line between the "low probable" and "high probable" points. There is approximately a 67% probability that the return over the next one year will lie within this "uncertainty range." Although no "absolute worst case" can be defined, a range roughly twice the size of the indicated range would cover more than 95% of the likely outcomes; 2.5% of any outcomes would result in a lower return and 2.5% would be even more favorable.

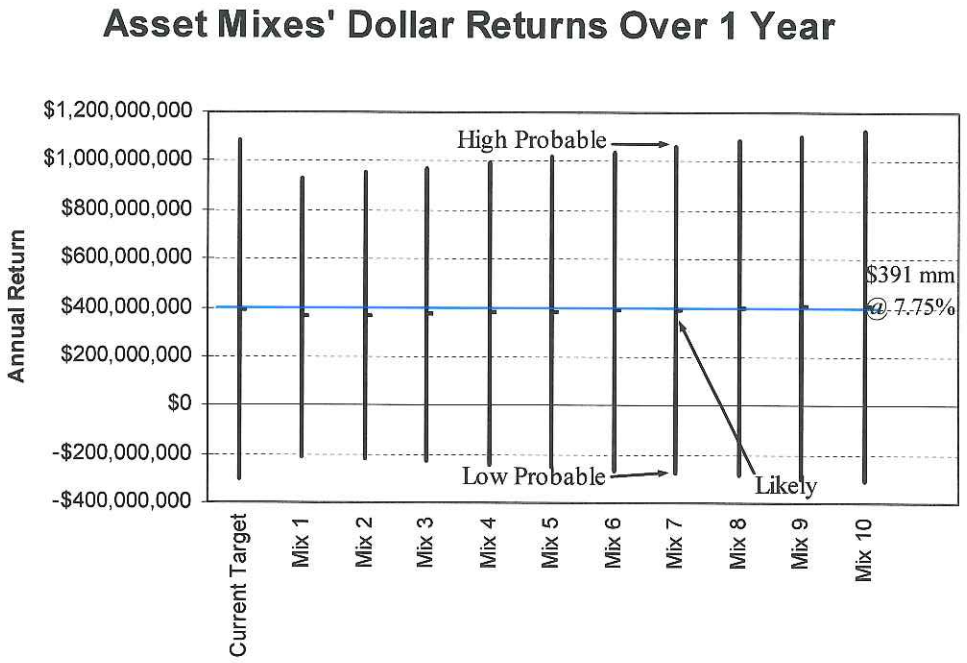


Figure 10

Mix 7 has an expected return that matches the actuarial assumed rate, and has an uncertainty range of $1.3 billion (the difference between the "low probable" and the "high probable." Again, these figures represent the dollars earned above or below the dollars earned if the Association's return were the target (hurdle) rate, 7.75%, for a one year period.

Longer-term Perspective

We also examined the variance of returns around the arithmetic mean over a five year time period. As shown in Figure 11 below, the expected range of returns is narrower than the range over the one year period. The expected return of each mix has a slightly higher probability of achieving the actuarial rate of return over the five year period versus the one year period.

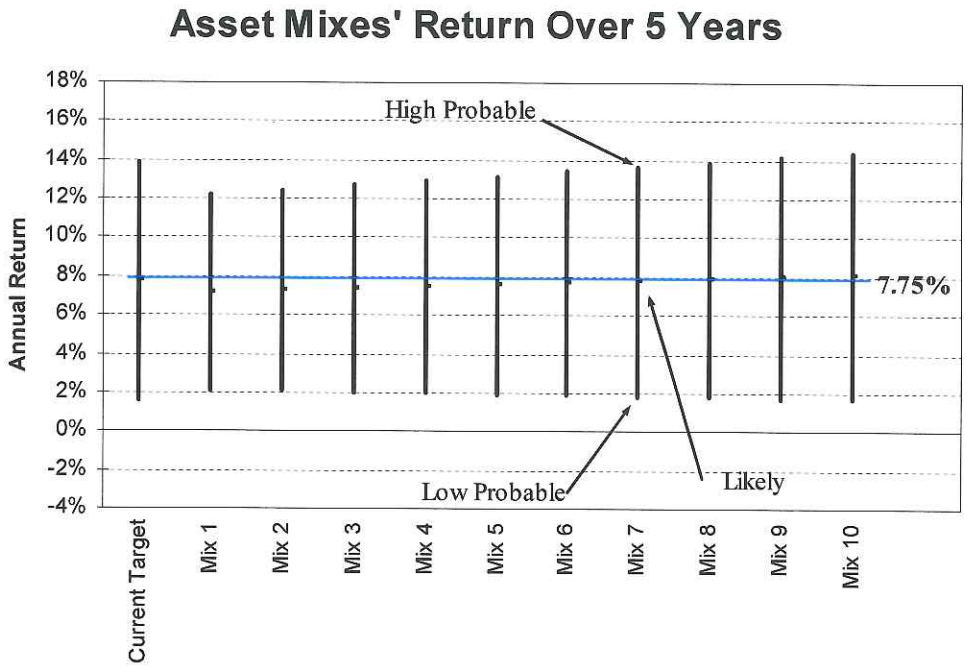


Figure 11

We also examine the variance of returns around the arithmetic mean over a longer time period. We believe that the appropriate policy frame is the time until the average liability is paid off – the "duration" of the liabilities. We recommend this planning horizon since it corresponds to actual benefits, rather than either the quarter-by-quarter perspective of the capital markets or the actuary's long-term perspective. In the liability section of this report, we reported its estimated value at 13.4 years. Looking at the longer horizon smoothes out short-term fluctuations.

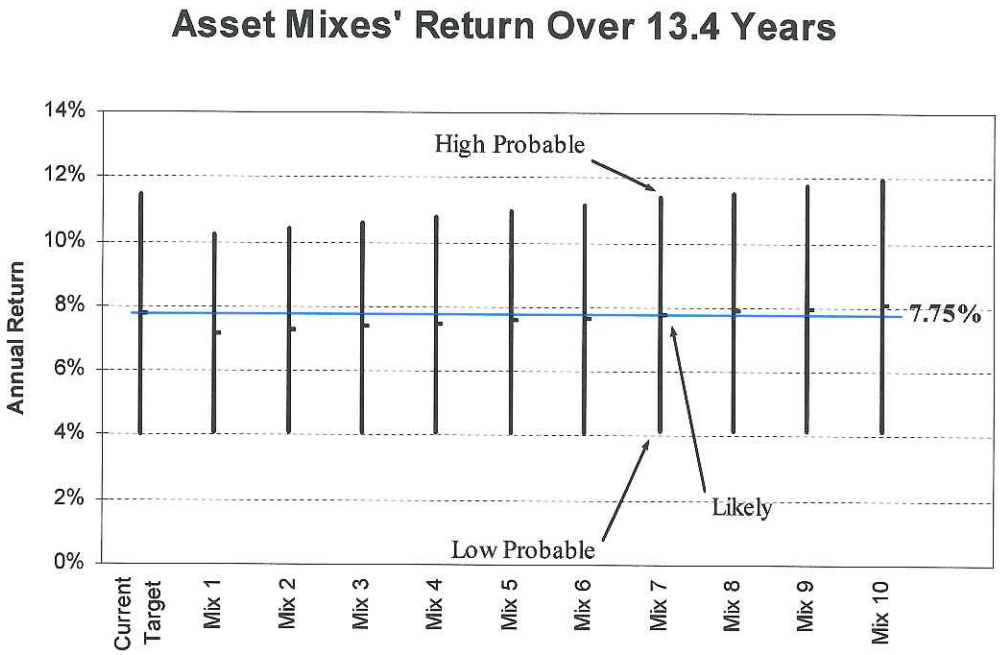


Figure 12

Figure 12 above shows how the expected range of return narrows when variability is spread over the 13.4 year liability horizon. The uncertainties appear substantially "tamed." Taking the longer term view to risk makes the more aggressive mixes look considerably more attractive than in the one-year chart. The likelihood of Mix 7 beating the 7.75% target over the 13.4 year period is 50%. The more aggressive mixes are shown as more likely to exceed the 7.75% target, with Mix 8 having a 51% chance of exceeding the 7.75% target, and Mix 10 having a 53% probability of beating the return hurdle.

RECOMMENDATION AND CONCLUSION

A case could be made that the Contra Costa County Employees' Retirement Association could adopt many of the proposed asset mixes. However, the proposed Mix 7 and alternative Mixes 6 and 8 all provide excellent diversification, and keep the chance of one year losses contained. The assets in Mix 7 match up reasonably well with the liabilities. We propose the adoption of Mix 7 among the narrowed asset mix range, which offers a reasonable return and is better diversified than the current target mix. As noted in the introduction of this report, we also encourage the Board to give serious consideration to Mix 8, with its higher expected return.

The Current Target, Proposed and Alternative Asset Mixes are detailed below.

Component	Current Target	Alternative Mix 6	Recommended Mix 7	Alternative Mix 8	Proposed Ranges of Mix 7
Global Equities	49.0	39.2	41.0	42.6	37-45%
Global Fixed	24.0	22.8	21.0	19.4	17-25%
High Yield	3.0	5.0	5.0	5.0	2-9%
Long Bonds	5.0	5.0	5.0	5.0	2-9%
Real Estate	11.5	12.5	12.5	12.5	9-15%
Alternatives	7.0	10.0	10.0	10.0	5-12%
Inflation Hedge	0.0	5.0	5.0	5.0	0-10%
Cash	0.5	0.5	0.5	0.5	0-1%
Return, %/yr	7.75	7.65	7.75	7.85	
Standard Deviation, %/yr	13.69	12.94	13.26	13.57	
Total Plan Risk, %/yr	18.19	17.79	18.05	18.31	

APPENDIX A - BASIS FOR CAPITAL MARKET ASSUMPTIONS

Global Equities: Expected returns for stocks are derived from analyses of historic returns, forecasts of the MSCI All Country World Index performance, and the expected economic environment. Return expectations are based on an analysis of historical results, consensus expectation and our proprietary analysis. Risk (the annual standard deviation of returns for stocks) is estimated based on historical data over different time periods.

Global Fixed Income: Expected returns and risk (standard deviation) for bonds are projected for the Barclays Aggregate Bond Index.

High Yield Fixed Income: Expected returns and risk (standard deviation) for bonds are projected for the Merrill Lynch High Yield Bond Index.

Long-Duration Fixed Income: Expected returns and risk (standard deviation) for bonds are projected for the Barclays Long Government/Credit Bond Index.

Global Real Estate: Expected returns and risk (standard deviation) are estimated using historical returns for institutional real estate investments. Historical data was analyzed using the FTSE EPRA / NAREIT Developed Real Estate Index.

Alternative Investments: Expected returns and risk (standard deviation) are estimated using UBS Private Equity Performance Indicator.

Inflation Hedge: : Expected returns and risk (standard deviation) are estimated using an equally weighted blended benchmark of the DJ UBS Commodity Index, Merrill Lynch U.S. TIPS Index and the NCREIF Timber Index.

91-Day Treasury Bills: Expected returns and risk (standard deviation) for 91-day Treasury Bills was estimated using historical data.

EXPECTED RETURNS

Expected returns are the most important input affecting the portfolio optimizer's choice of assets for optimal portfolios. The Global CAPM model requires estimates of the risk-free rate and the excess return of the global market portfolio over the risk-free rate. We estimate these two parameters by independently estimating returns for two key asset classes: U.S. large cap equity and U.S. core fixed income. We then solve for the risk-free rate and market excess return forecasts that, when used as inputs to the CAPM, generate expected returns for U.S. large cap equity and U.S. core fixed income that match our independent forecasts.

U.S. Stocks. To forecast the expected return on U.S. large cap equity, we use the S&P 500 Index and the Dividend Discount Model. According to this model, the expected long-term annualized return on the equity market is the sum of expected long-term inflation, the current dividend yield (based on next year's expected dividends), and the expected long-term real growth rate in dividends.

Our 10-year assumption for the annualized rate of inflation is 2.75%, unchanged from June 2010. We develop this assumption by looking at the difference between yields on nominal Treasury bonds and inflation-indexed Treasury bonds (so called "breakeven inflation"). We also consider published surveys of economists' forecasts for average price inflation over the next 10 years (December 2010 Blue Chip Financial Forecasts[1] and the 4th Quarter 2010 Survey of Professional Forecasters[2]).

The trailing dividend yield on the S&P 500 Index was 1.90% at the end of December 2010. We expect the real growth rate in dividends to match the real growth in corporate earnings which, in turn, should closely track, but not exceed, the real growth rate in GDP. The December 2010 issue of Blue Chip Financial Forecasts reports a consensus forecast for average U.S. real GDP growth of about 2.80% over the next 10 years. We use 2.60% as our forecast for the growth in real earnings and dividends. Therefore, the current dividend yield based on next year's expected dividend is 1.95% (1.90% x 1.026 = 1.95%). Adding the dividend growth rate to the yield gives us an expected real return of 4.55% (1.95% + 2.60% = 4.55%). Finally, we add (using geometric addition) expected inflation of 2.75% per year to adjust the real return to a nominal return. This leads to the expected annualized return for large cap equity of 7.42%.

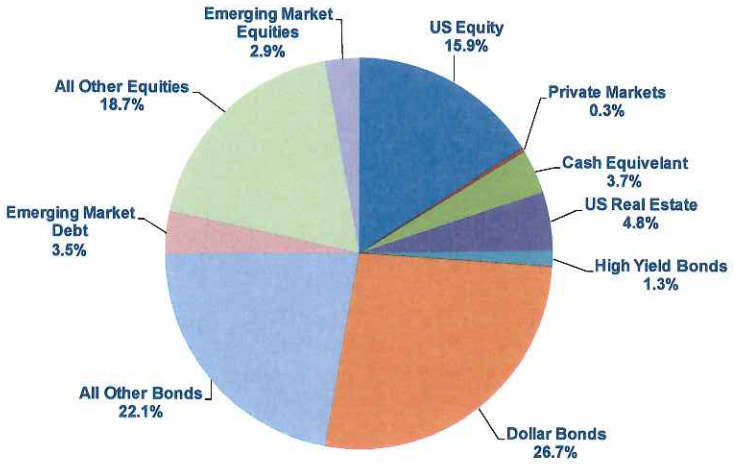
$$(1 + 4.55\%) \times (1 + 2.75\%) - 1 = 7.42\%$$

We round this result to 7.50%. We then compare the result from the Dividend Discount Model above with results developed from two other equity return forecasting models – the Smoothed Earnings Yield Model and the Equity Risk Premium Model[3].

U.S. Bonds. We assume that the yield to maturity of each U.S. fixed income asset class (except high yield) will move over the next five years from its current level to an expected level. The expected level is equal to the forecasted yield of the 10-year Treasury bond in 5 years based on consensus forecasts (5.10%) plus the asset class's average historical yield spread to the 10-year Treasury bond (0.44% since 1990). Expected 10-year returns reflect the impact of this yield movement.

The yield to maturity of the Barclays Capital Aggregate Bond Index was 2.97% at the end of December 2010. Applying this process leads to an expected annualized yield of 5.54% in 5 years and an annualized return of 3.50% over the 10-year period.

Other Asset Classes. A Global CAPM process is used to reverse engineer expected returns of the various other asset classes. Expected returns are proportional to their systematic risk (beta) relative to this global portfolio, defined as the estimate of the market capitalization of all investable assets. Milliman uses the global portfolio developed by UBS Global Asset Management. Current weights are shown below:



Source: UBS Global Asset Management

The returns of market indices representing each of the asset classes are weighted by their current weights to create a global portfolio return series. Regression of each individual asset class return against the global portfolio return produces a beta for each asset class. Beta is the measure of sensitivity of the asset class return to changes in the global portfolio return (technically the slope of the regression line) and reflects the systematic risk of that asset class.

Assumptions for assets that are not included in the global portfolio and/or those that are privately valued are adjusted through either their standard deviations or their betas (systematic risk), which serves to increase their risk premia. For private investments and strategies such as hedge funds, alpha has been added to reflect investor expectations

STANDARD DEVIATIONS AND CORRELATIONS

Standard deviations and correlations are based on quarterly historical data from 1990 through 2010. Standard deviations have been adjusted to reflect projected market conditions. Results from quarterly calculations are converted to annualized standard deviations using an estimation method.

Footnotes

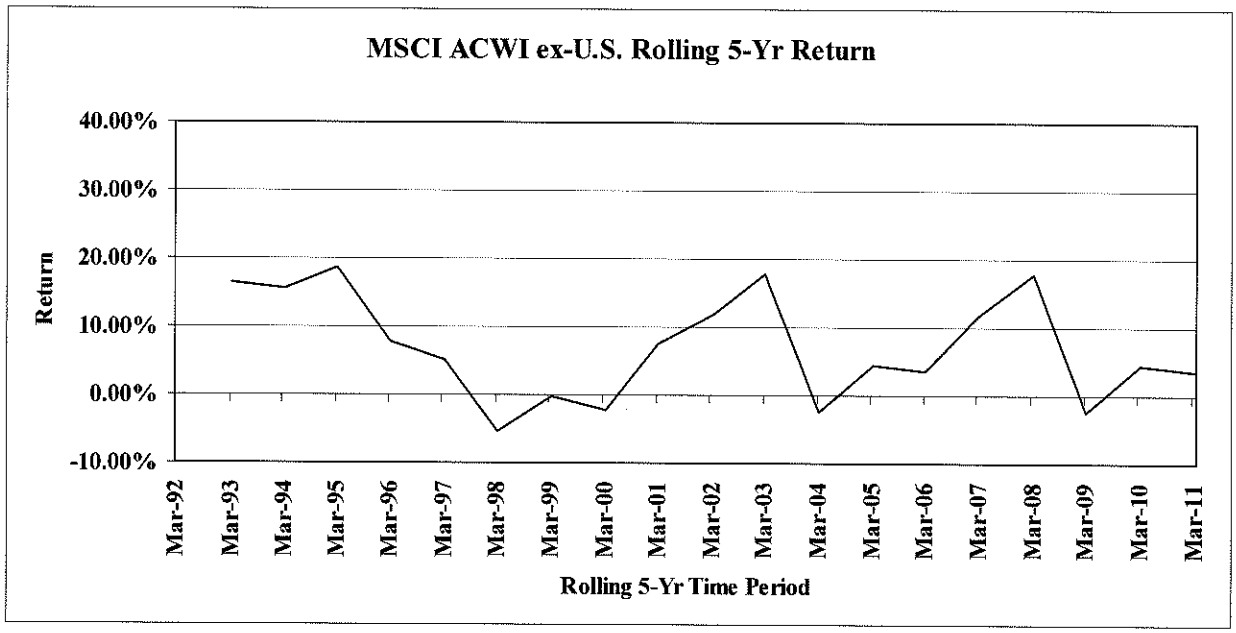
1. The Blue Chip Financial Forecasts is published monthly by Aspen Publishers and includes forecasts from approximately 45 professional economists on interest rates, inflation, and economic output.
2. The Survey of Professional Forecasters is published quarterly by the Federal Reserve Bank of Philadelphia and includes forecasts from approximately 35 professional economists on interest rates, inflation, and economic output.
3. The Smoothed Earnings Yield Model, developed by Yale professor Robert Shiller, suggests that the long-term real return on the equity market will be close to the ratio of smoothed earnings (the inflation-adjusted average earnings over the previous 10 years) to the current inflation-adjusted price. This model suggests that the expected real long-term return on the S&P 500 Index will be approximately 4.91%. Combining this geometrically with expected inflation of 2.75% leads to an expected annualized return of 7.79%.

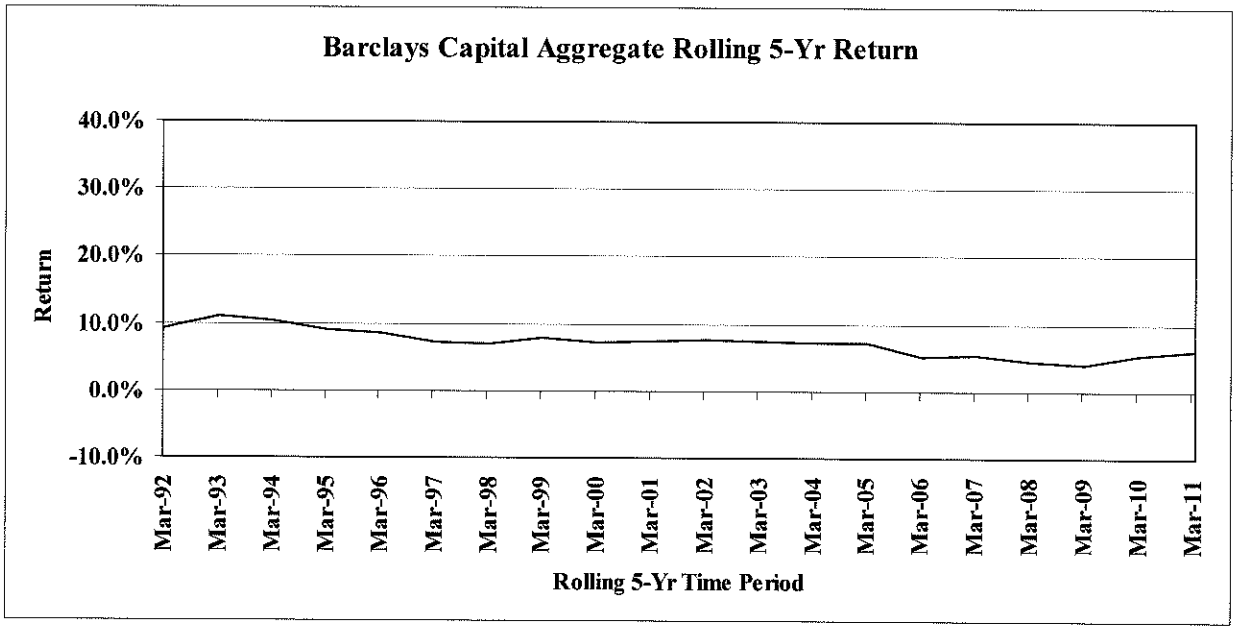
   The Equity Risk Premium Model suggests that the return on the equity market will be close to the current yield to maturity on long Treasury bonds plus a risk premium demanded by equity investors. The yield to maturity on 20-year Treasury bonds was 4.19% at the end of December 2010. Combining this geometrically with an adjusted measure of the historical equity risk premium developed by Dimson, Staunton, and Marsh (2.40%) produces an expected annualized return of 6.69%.

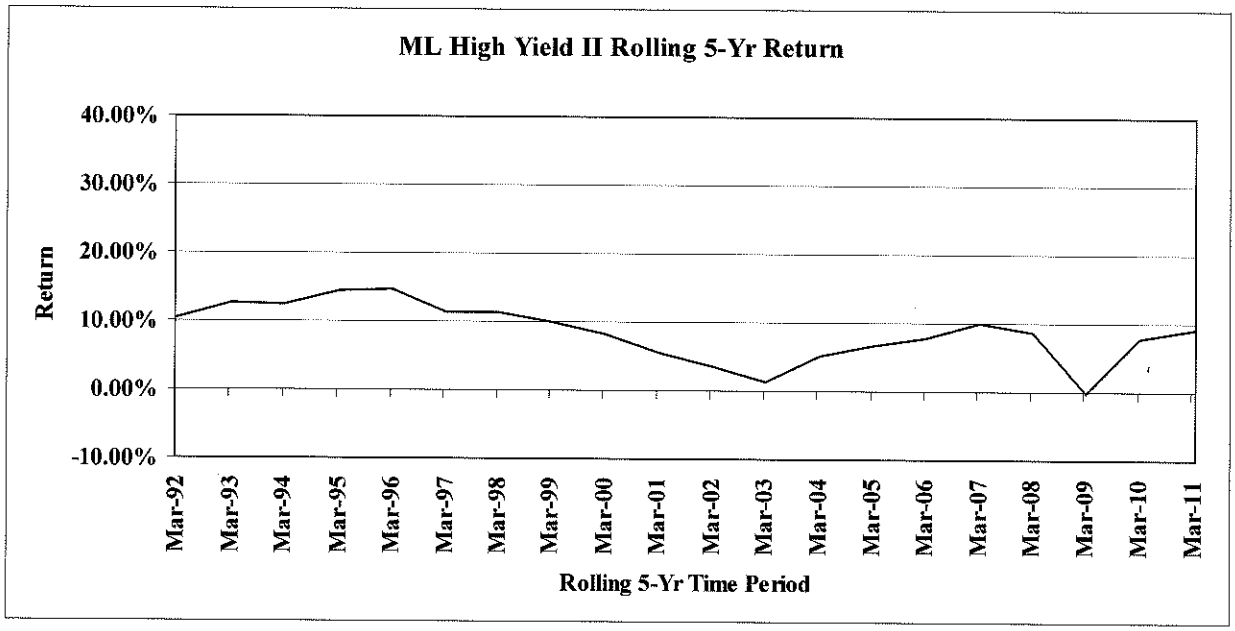
Although these two models produce different expected equity market returns at the end of 2010, we believe that they are equally relevant and give them equal weight in terms of predicting equity returns. The average of the two forecasts is 7.24% which is close to the 7.50% developed with the Dividend Discount Model.

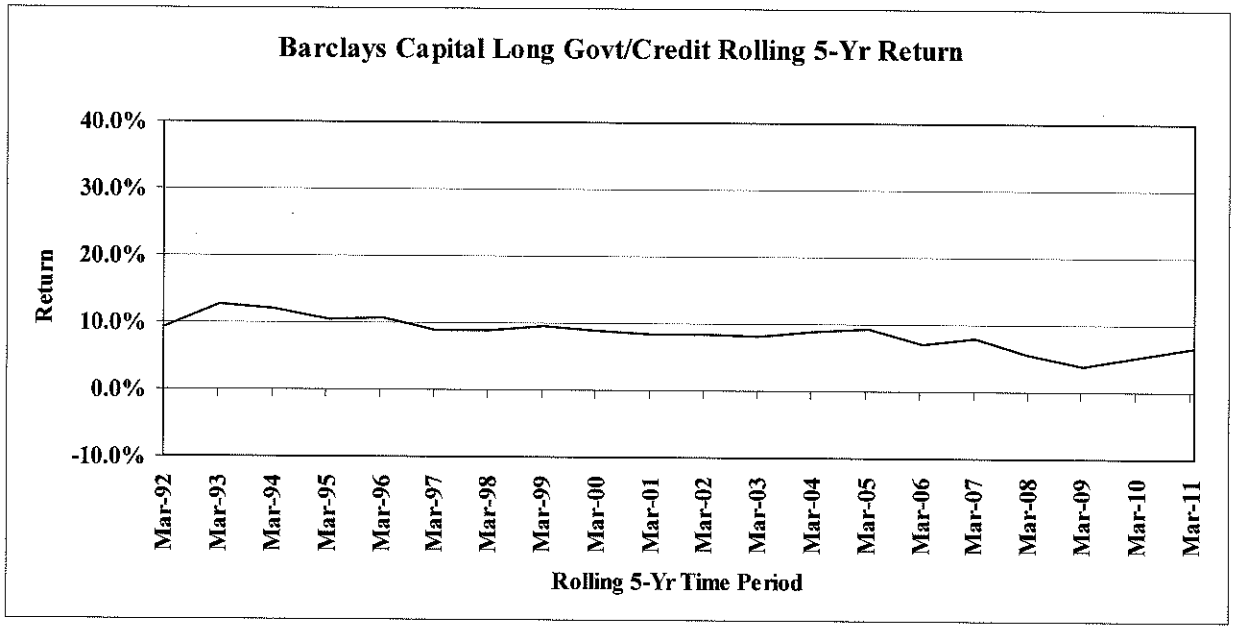
Rolling Five-Year Performance

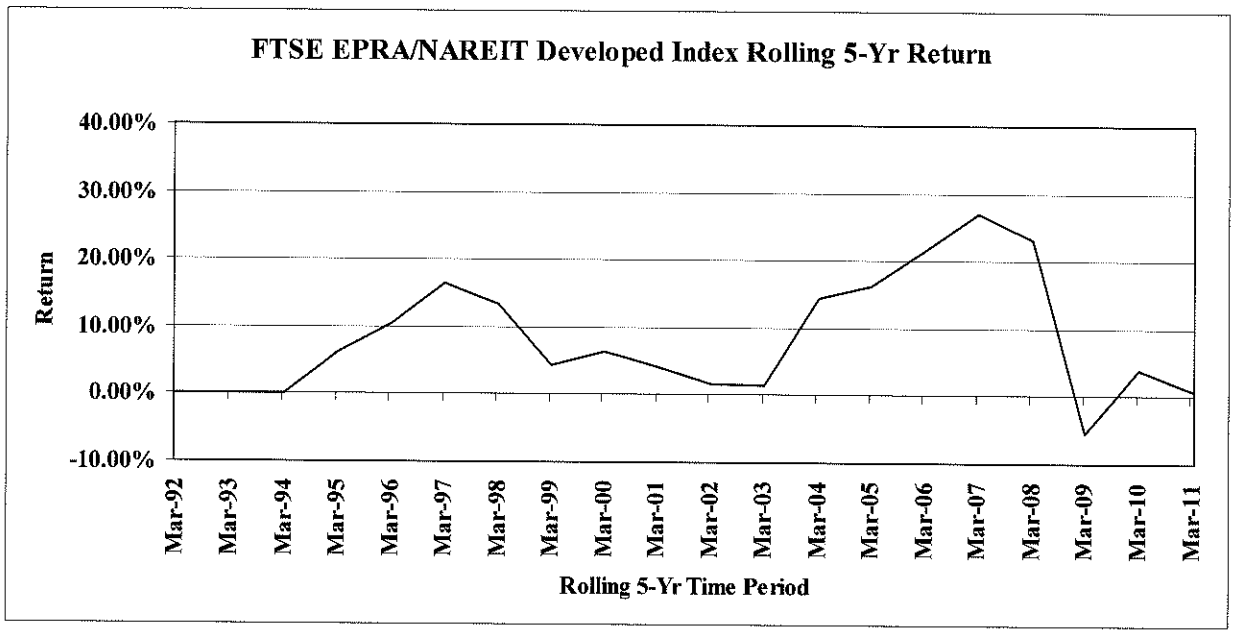
We calculated the cumulative annualized returns of each asset class over multiple rolling 5-year time periods. For example, for stocks, we had data spanning over twenty years. We calculated a five-year return for the beginning of this period. This time period started with second quarter 1987 and went through first quarter 1992. Then the next quarter's return for the Russell 3000® was added to the respective time series and the oldest quarterly return was dropped. The stock return over this new five-year time period was then calculated. This procedure was repeated through the latest five-year period covering second quarter 2006 through first quarter 2011.






ML High Yield II Rolling 5-Yr Return
40.00%
30.00%
20.00%
10.00%
0.00%
-10.00%
Return
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Rolling 5-Yr Time Period


Barclays Capital Long Govt/Credit Rolling 5-Yr Return
40.0%
30.0%
20.0%
10.0%
0.0%
-10.0%
Return
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Rolling 5-Yr Time Period


FTSE EPRA/NAREIT Developed Index Rolling 5-Yr Return
40.00%
30.00%
20.00%
10.00%
0.00%
-10.00%
Return
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
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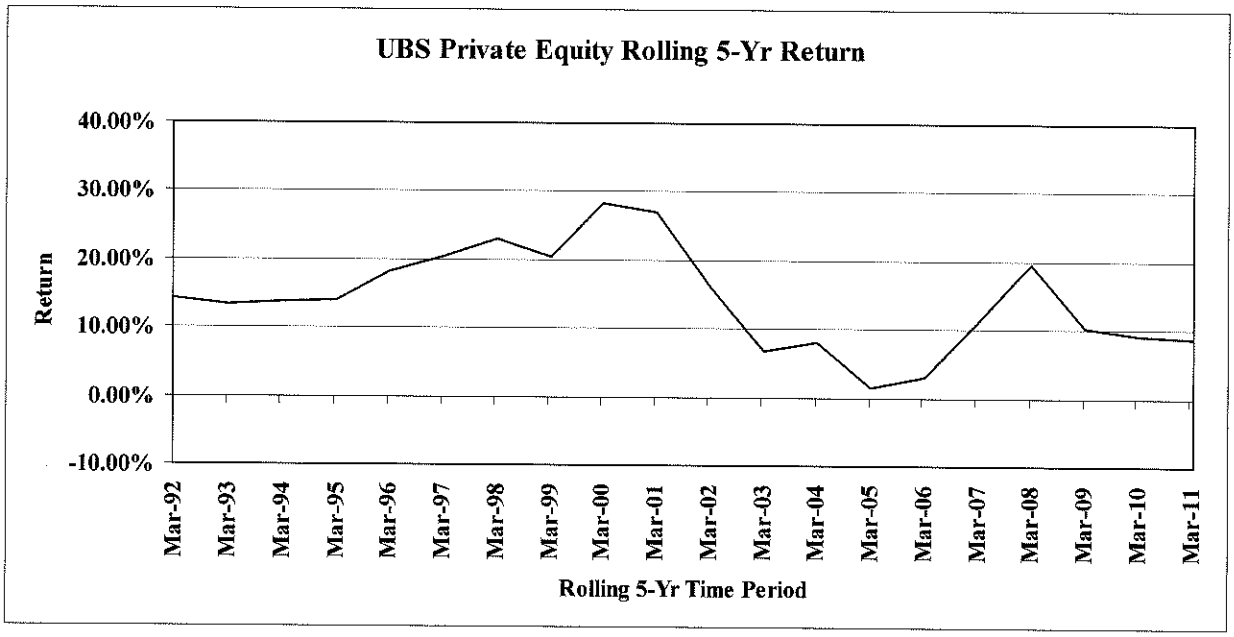
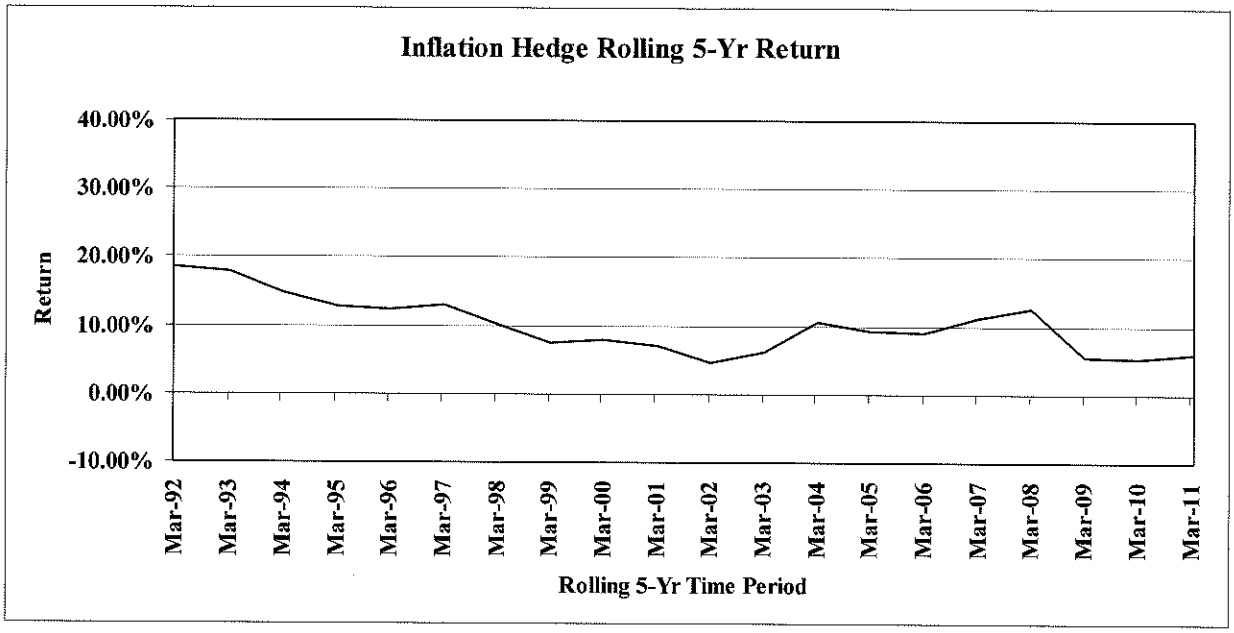
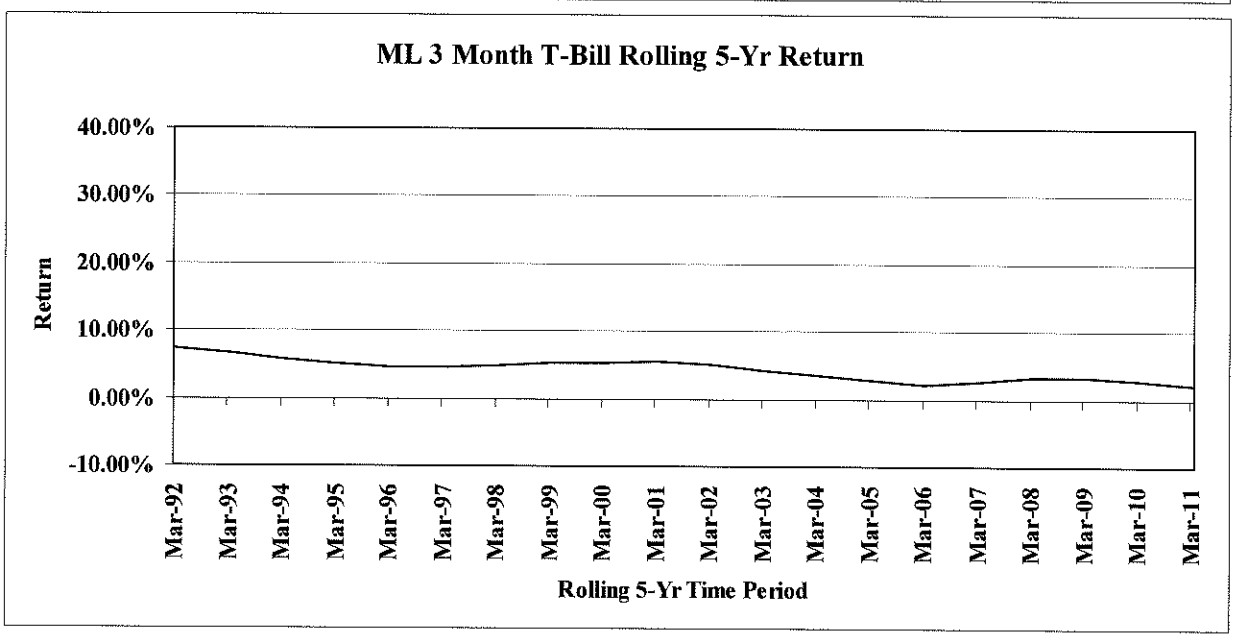
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Rolling 5-Yr Time Period


UBS Private Equity Rolling 5-Yr Return
40.00%
30.00%
20.00%
10.00%
0.00%
-10.00%
Return
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Rolling 5-Yr Time Period


Inflation Hedge Rolling 5-Yr Return
40.00%
30.00%
20.00%
10.00%
0.00%
-10.00%
Return
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Rolling 5-Yr Time Period


ML 3 Month T-Bill Rolling 5-Yr Return
40.00%
30.00%
20.00%
10.00%
0.00%
-10.00%
Return
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Rolling 5-Yr Time Period

APPENDIX B – ASSET CLASS CORRELATIONS

As part of our research effort on the assumptions used in the asset allocation review, we review the correlation trends between bonds and the other asset classes. The correlation between bonds and other asset classes are particularly critical. Bonds are the asset class that is most highly correlated with plan liabilities, and thus are somewhat representative of the correlation between the liabilities and the asset classes. The correlation between the assets and the liabilities is central to the asset allocation process. These historical correlations are explored below.

Procedure Used to Calculate Correlations

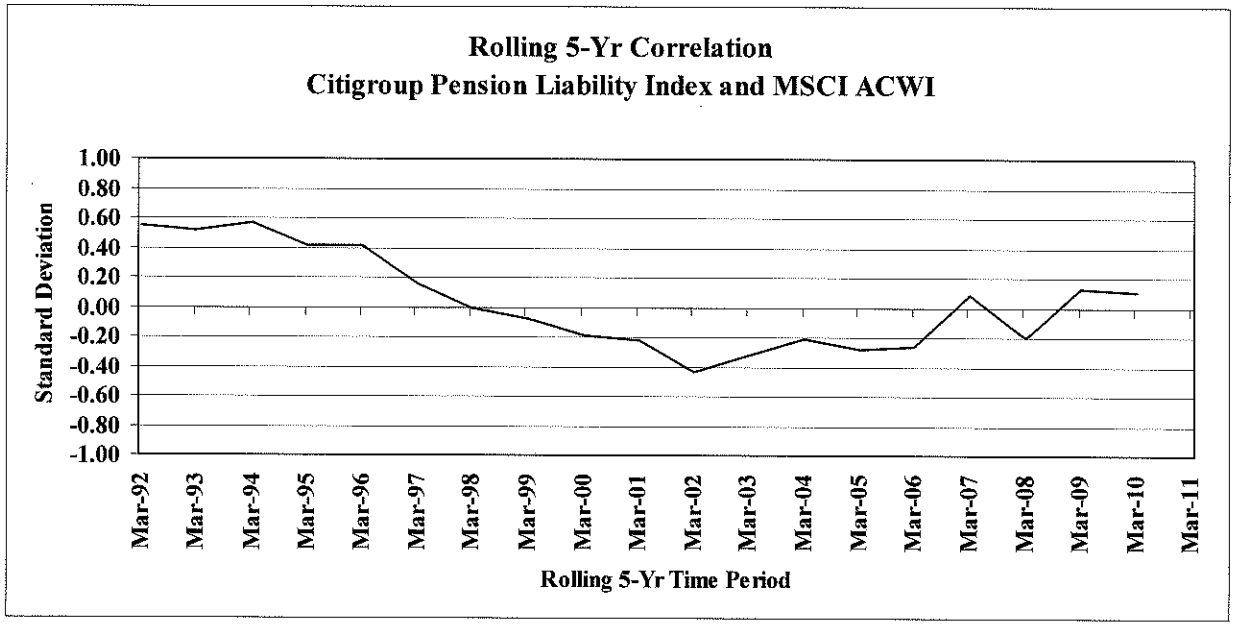
The procedure to generate correlations with liabilities involved several steps. We calculated the correlation between two asset classes over multiple rolling time periods. For example, for bonds and stocks, we had data spanning over twenty years. We then calculated a five-year correlation of the beginning of this period. This time period started with second quarter 1987 and went through first quarter 1992. Then the next quarter's return for stocks and bonds was added to the respective time series and the oldest quarterly return was dropped. The correlation coefficient was calculated on the stock and bond returns over this new five-year time period. This procedure was repeated through the latest five-year period covering second quarter 2006 through first quarter 2011. We were able to generate 77 correlations using this procedure.

We also examined the relationship between bond indices of varying duration. The liabilities are similar to a bond portfolio in their response to changes in inflation and interest rates. Thus, by supplementing the work presented below with a close examination of the relationships between bond indices of varying duration we were able to gather valuable information regarding key relationships. Specifically, the connection between the liabilities and the asset classes as well as between long-term bonds and other asset classes. In general, we found that bond portfolios of varying duration were consistently very highly correlated over time. We also found that the closer the duration of two bond portfolios are, the higher the correlation tends to be.

Citigroup Pension Liability Index and Global Equities

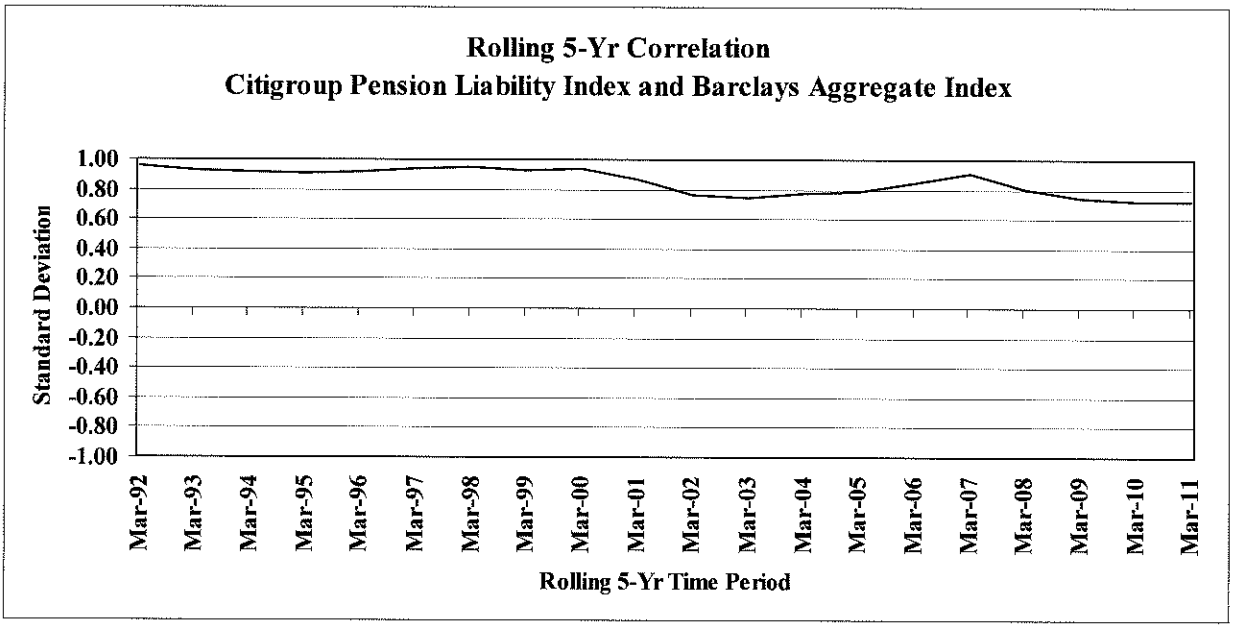
Global equities are represented by the Morgan Stanley Capital International (MSCI), All County World (ACWI) Index. The underlying indexes used to calculate the correlations between global equities and bonds were the Citigroup Pension Liability Index and the MSCI ACWI. Rolling five-year correlations were calculated over the past twenty years.

The 5-year rolling period ending March 1993 has a correlation of +0.55. After the first quarter 1993, the correlation gradually falls to a low of -0.43 in the first quarter 2003. The correlation remains negative through the first quarter 2007, with a correlation of -0.26. Subsequent to this period, the correlation climbs to +0.10 for the 5-year rolling period ending the first quarter 2011. This data suggests that the relationship between the pension liability and global stocks can vary dramatically, but is likely to be within the range of -0.40 and +0.40 when markets are in equilibrium.



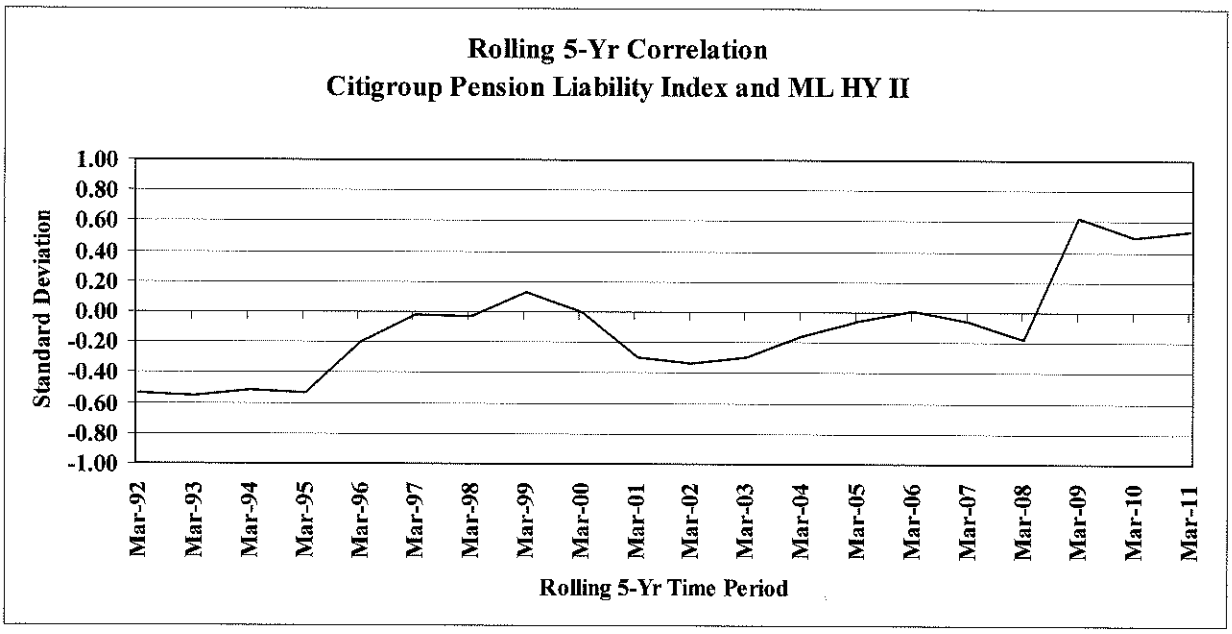
Citigroup Pension Liability Index and Global Bonds

Global bonds are represented by the Barclays Capital Aggregate Index. Correlations between the Barclays Aggregate and the pension liability has been relatively high, with a range between +0.72 and +0.96. In more recent periods, the correlation has gradually declined but has settled at an average of +0.73 over the 5-year rolling periods between 2009 and 2011. It is our expectation that a correlation range between +0.70 and +0.96 is likely going forward.



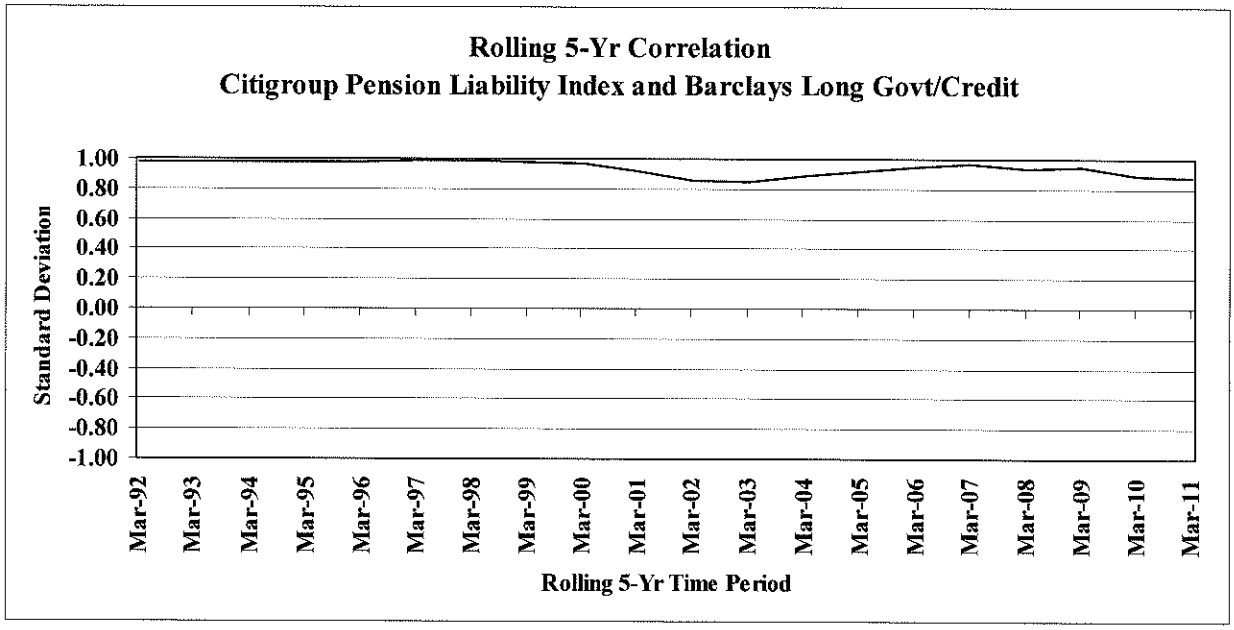
Citigroup Pension Liability Index and Domestic High Yield Bonds

High yield bonds are represented by the Merrill Lynch High Yield II Bond Index. The correlation over the period exhibited ranges from a low of -0.56 in the first quarter 1993 to a high of +0.63 in the 5-year rolling period ending the first quarter 2009. The correlation is +0.54 for the most recent 5-year rolling period ending the first quarter 2011. It is our expectation that a correlation range between -0.40 and +0.50 is likely going forward.



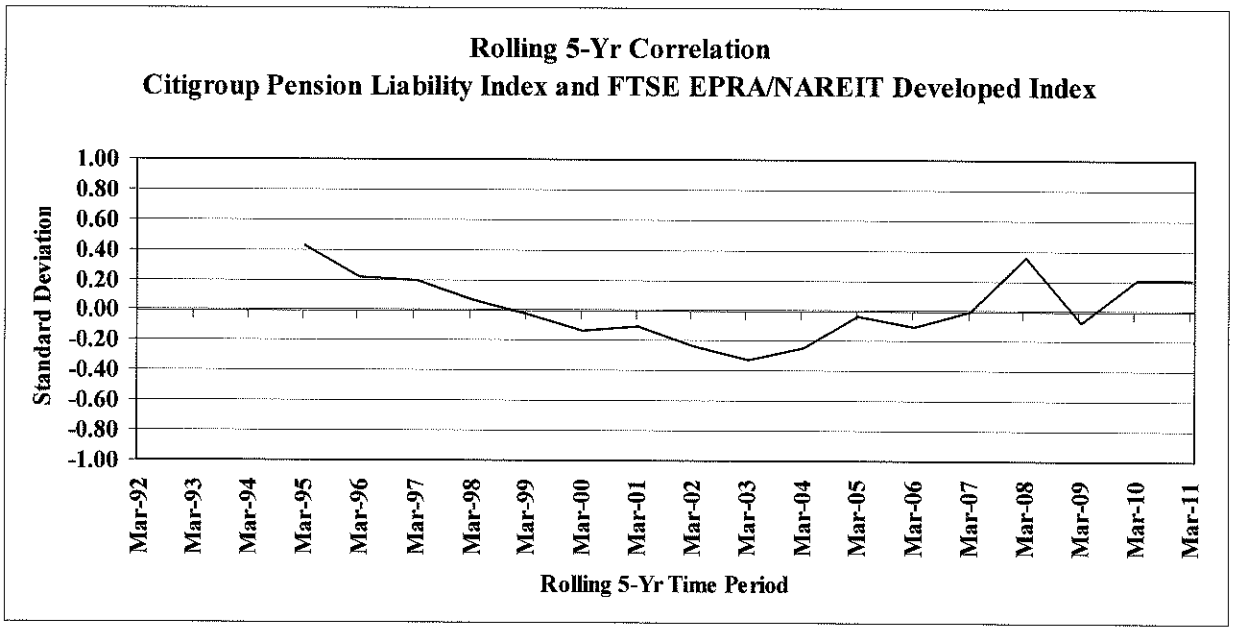
Citigroup Pension Liability Index and Long Bonds

Long bonds are represented by the Barclays Long Government/Credit Index. The correlation over the entire period is within the range of +0.85 to +0.99. Within the earlier years of 1992 to 2000, the correlation is fairly steady and hovers around +0.98. Subsequently, the correlation falls to +0.85 in 2002. From that point on, the correlation had climbed to +0.97 in 2007 before falling to +0.88 for the most recent period. Going forward, we estimate the correlation will be between +0.85 and +0.95.



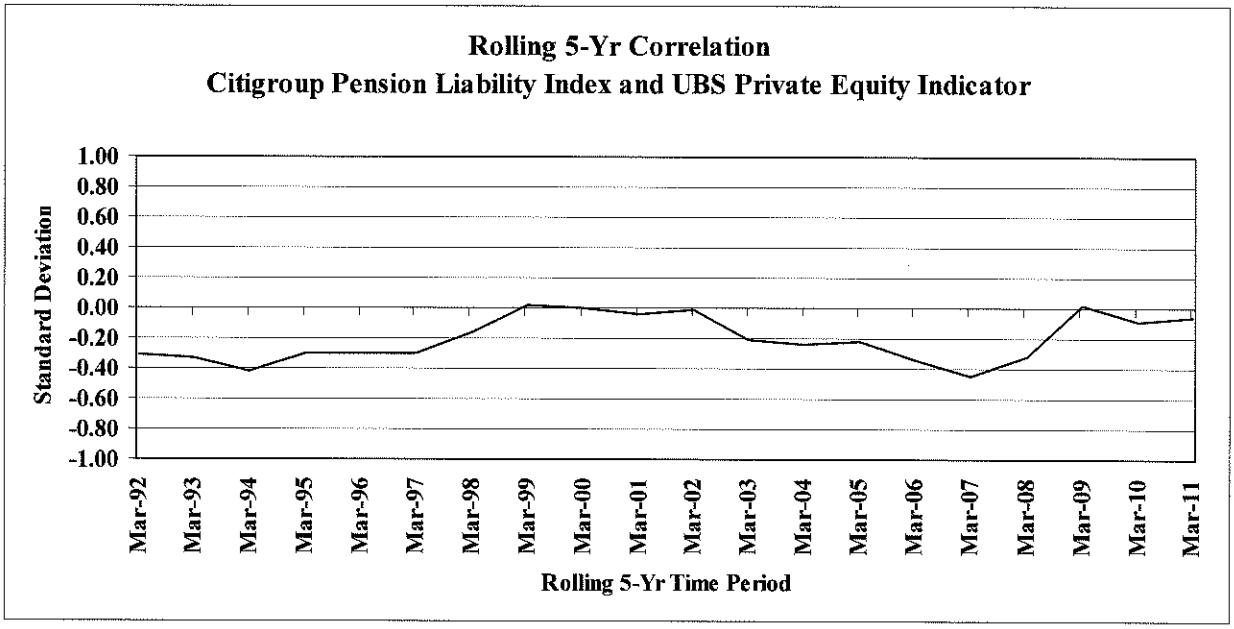
Citigroup Pension Liability Index and Global REITS

Global REITS are represented by the FTSE EPRA/NAREIT Developed Index. The correlation has ranged between -0.33 and +0.43 over the last 20 years, on a 5-year rolling basis. The five-year rolling correlation over the earliest available periods shows a decline from +0.43 in 1995 to -0.33 in 2003. Since 2003, the correlation has been on an upward climb and has recently reached +0.21 for the 5–year rolling period ending the first quarter 2011. Going forward, we estimate the correlation will be between -0.20 and +0.20.



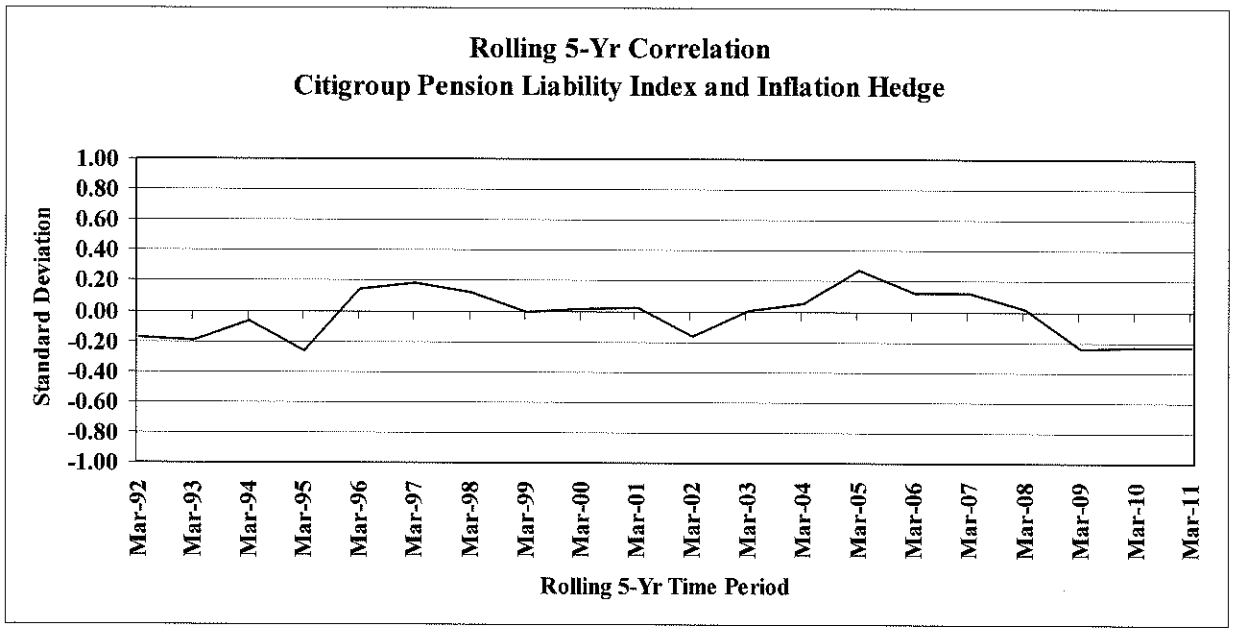
Citigroup Pension Liability Index and Alternative Investments

The Index used for this analysis is the UBS Private Equity Performance Indicator. Prior to reaching zero in 2000, the correlation over the earliest periods ranges from a low of -0.42 in 1994 to a high of +0.02. Subsequently, the correlation falls to its lowest point of -0.45 in 2007 and has since reached a correlation of -0.06 for the 5-year rolling period ending the first quarter 2011. Going forward, we estimate the correlation between bonds and high yield issues will be between -0.40 and +0.05.



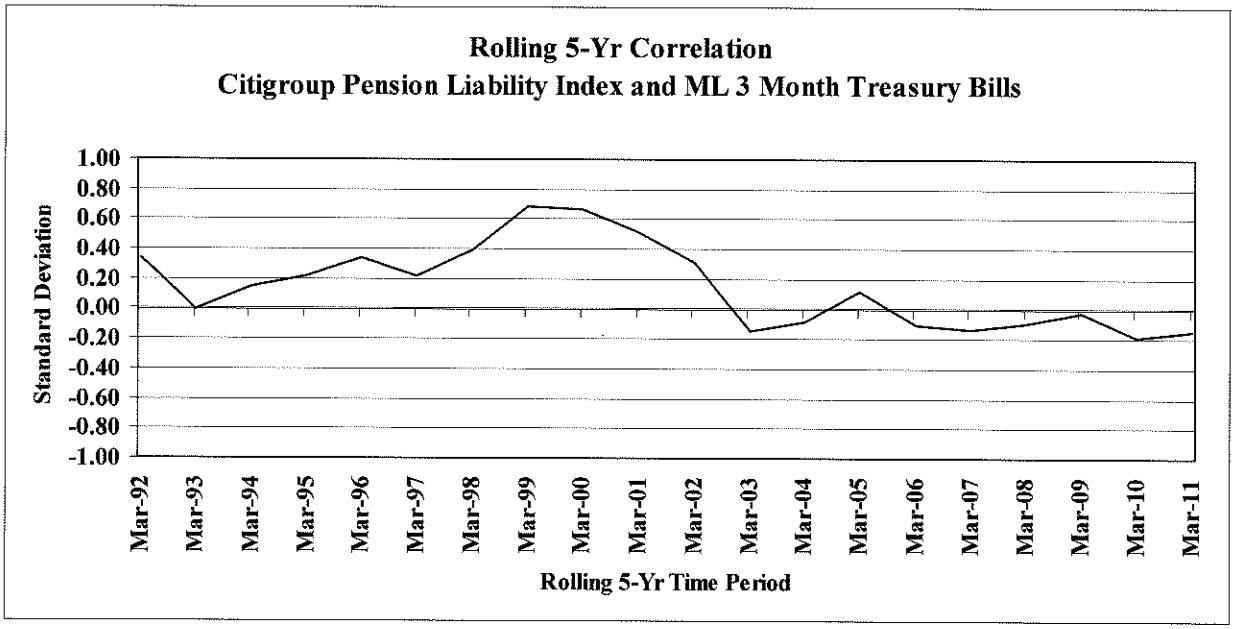
Citigroup Pension Liability Index and Inflation Hedge

The Index used for this analysis is an equally weighted blended benchmark of the DJ UBS Commodity Index, Merrill Lynch U.S. TIPS Index and the NCREIF Timber Index. The 5-year rolling correlation over the periods observed has risen from its period low of -0.26 in 1995 to -0.23 in 2011. We estimate the correlation will be between -0.20 and +0.20 over the next five years.



Citigroup Pension Liability Index and Merrill Lynch 3 Month Treasury Bills

Until recently, Citigroup Pension Liability Index and 3 Month Treasury Bills have historically been positive. The correlation reached a high of +0.68 in 1999 before falling to negative territory subsequent to 2003. The rolling correlation has since remained negative and is -0.15 for the most recent period. We expect that the correlation is likely to be between -0.10 and +0.10 over the next three to five years.



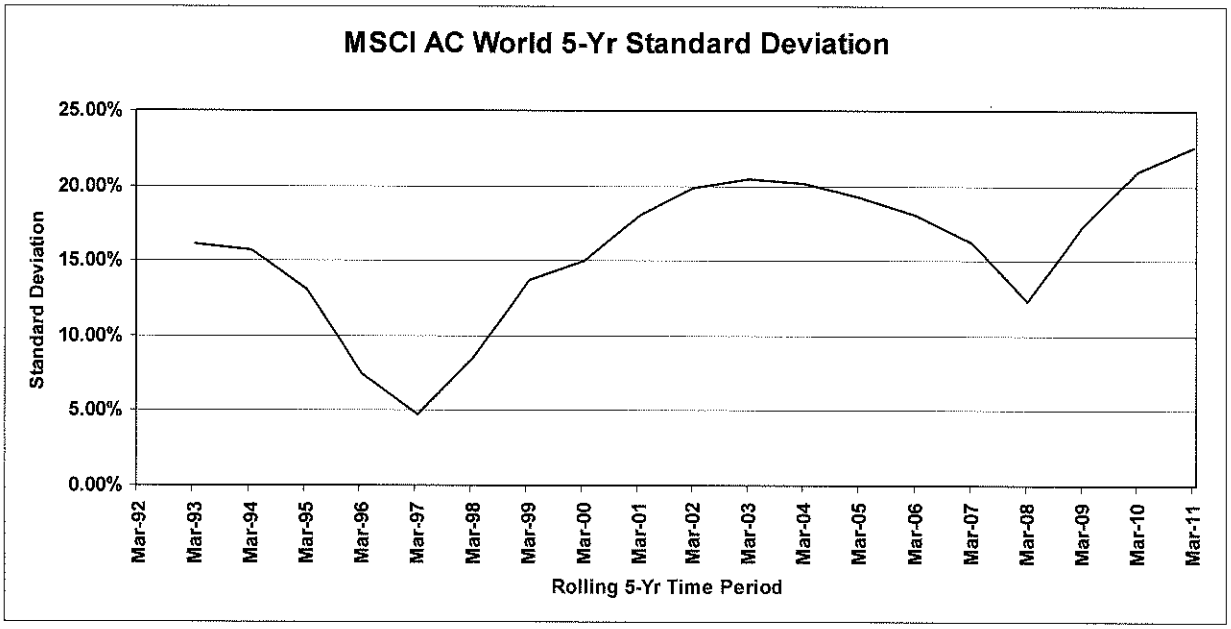
APPENDIX C – ASSET CLASS RISK

Due to more volatile correlations between the asset classes, we felt it was appropriate to review the historical levels of volatility as well. We calculated the risk of each asset class, as represented by the standard deviation, using the same rolling five-year methodology that was used for calculating the correlation coefficients. If possible, we calculated the rolling standard deviation of each asset class over the last twenty-year period. For example, for large/mid cap stocks, the first time period for the rolling five-year risk started with second quarter 1987 through first quarter 1992. Then the next quarter's return for stocks was added to the respective time series and the oldest quarterly return was dropped. The standard deviation of the returns of the asset class was calculated over this new five-year time period. This procedure was repeated through the latest five-year period covering second quarter 2006 through the first quarter 2011. We were able to generate 77 standard deviations using this procedure. The results and our future expectations are listed on the following pages.

Global Equities

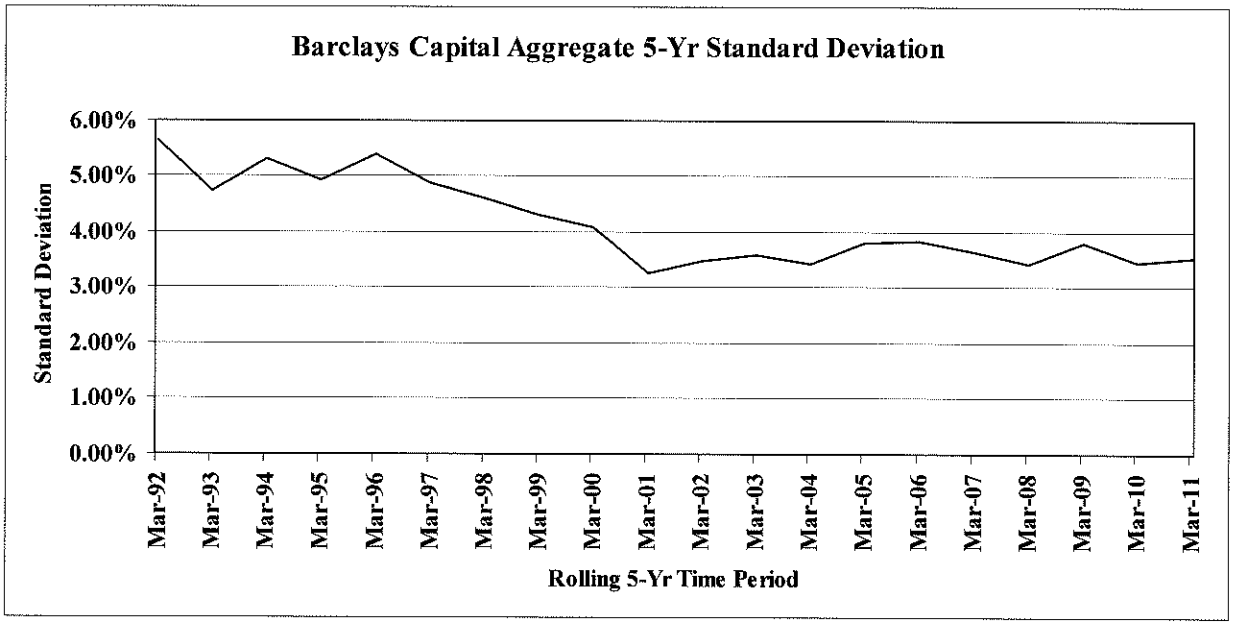
The underlying index used to calculate the standard deviation of domestic stocks was the MSCI ACWI.

Prior to 1997, the standard deviation fell from 16% in 1993 to its period low of 4.8%. Subsequently, the standard deviation has steadily climbed to its period high of 22.6% for the period ending the first quarter 2011. We expect the risk to be between 10.0% and 20.0% over the next five years.



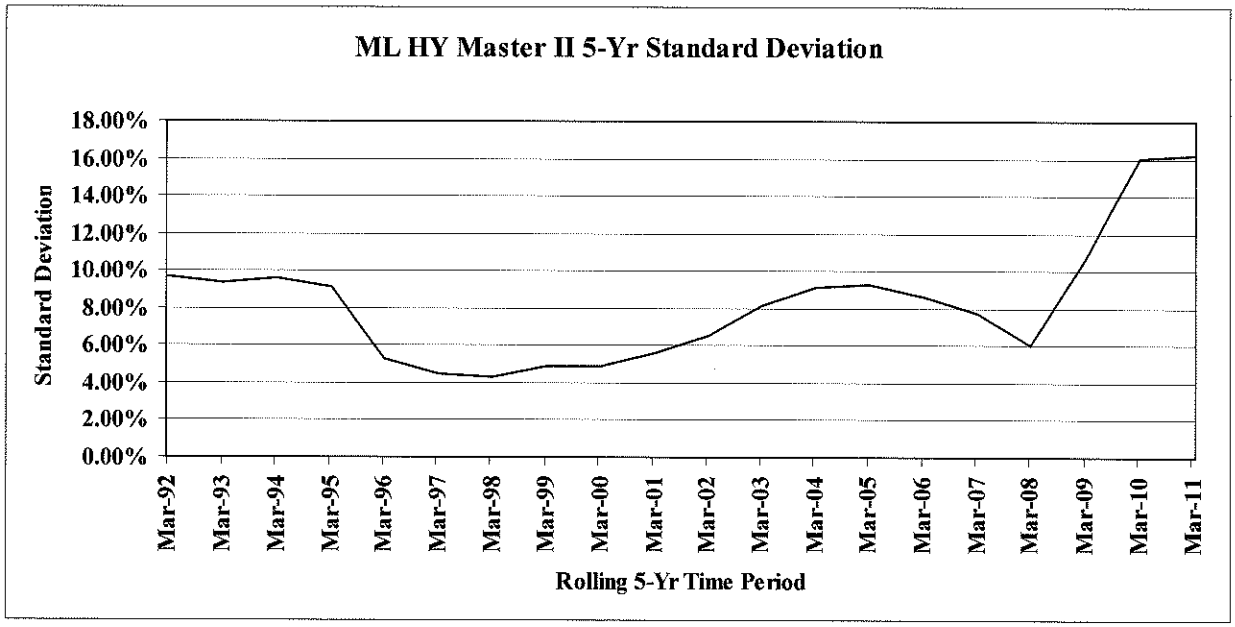
Global Bonds

Global bonds are represented by the Barclays Aggregate Index. From 1992 through 2001, the rolling standard deviation gradually fell from a period high of 5.6% to its low of 3.3%. The standard deviation climbed to 3.8% in 2006 before falling to 3.5% for the period ending the first quarter 2011. It is our expectation that the risk level will range between 3.0% and 4.0% going forward.



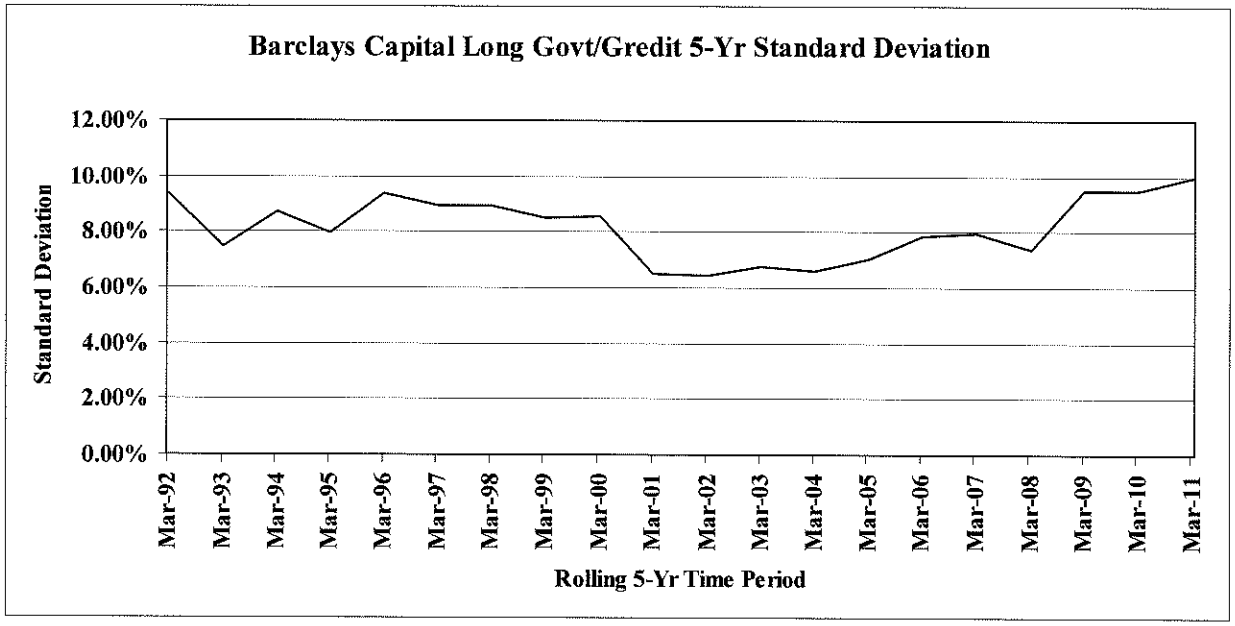
High Yield Bonds

High yield bonds are represented by the Merrill Lynch High Yield Master II Index. Between 1992 and 1995, the standard deviation remained above 9%. The standard deviation subsequently fell to a low of 4.3% in 1998 before steadily climbing to its period high of 16.2% for the period ending the first quarter 2011. It is our expectation that the risk level will range between 10% and 15% going forward.



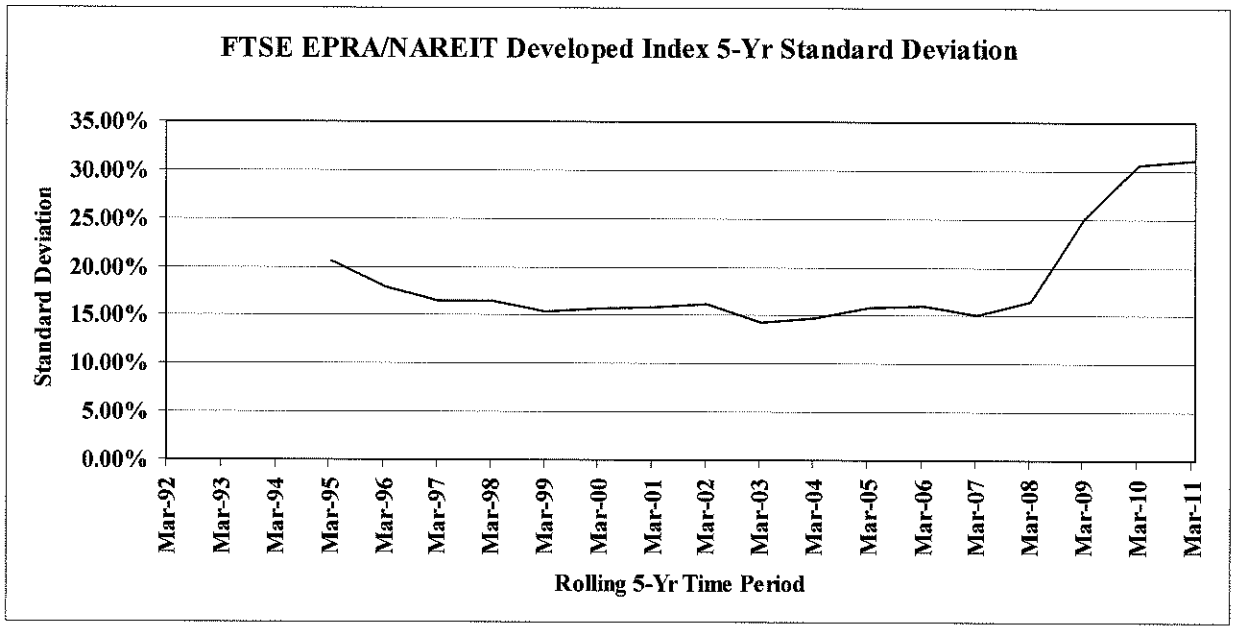
Long Duration Fixed Income

The standard deviation of long bonds, as represented by the Barclays Long Government/Credit Bond Index, has ranged between 6.4% and 10.0% over most of the observed time periods. The standard deviation was at least 8.0% for all periods prior to 2000. The standard deviation fell to its period low of 6.4% in 2002. Subsequently, the standard deviation has gradually climbed to its period high of 10.0% for the most recent period. We believe that a standard deviation of between 5.0% and 10.0% to be likely going forward.



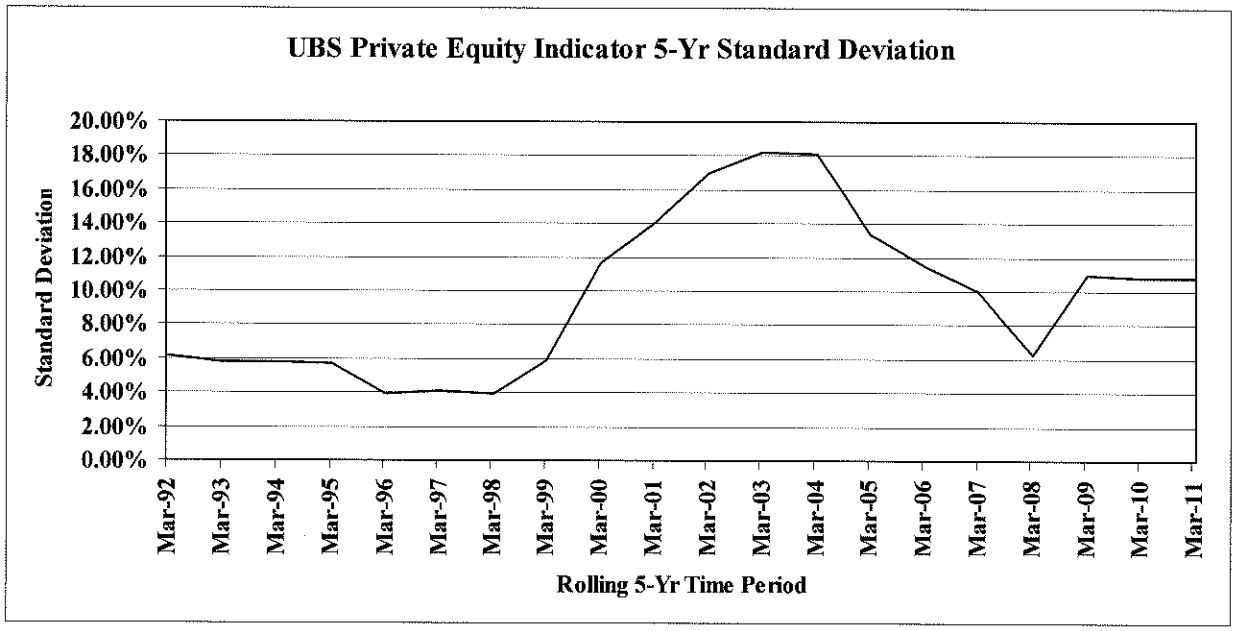
Global REITS

The standard deviation of global REITS, as measured by the FTSE EPRA/NAREIT Developed Index, has been between 14.4% and 31.1% since the earliest observable period. The standard deviation has remained relatively stable and within the 15.0% to 20.0% range prior to 2008. Since 2008, the standard deviation has climbed steeply to a period high of 31.1% for the most recent period. We believe that a standard deviation of between 15.0% and 25.0% is likely going forward.



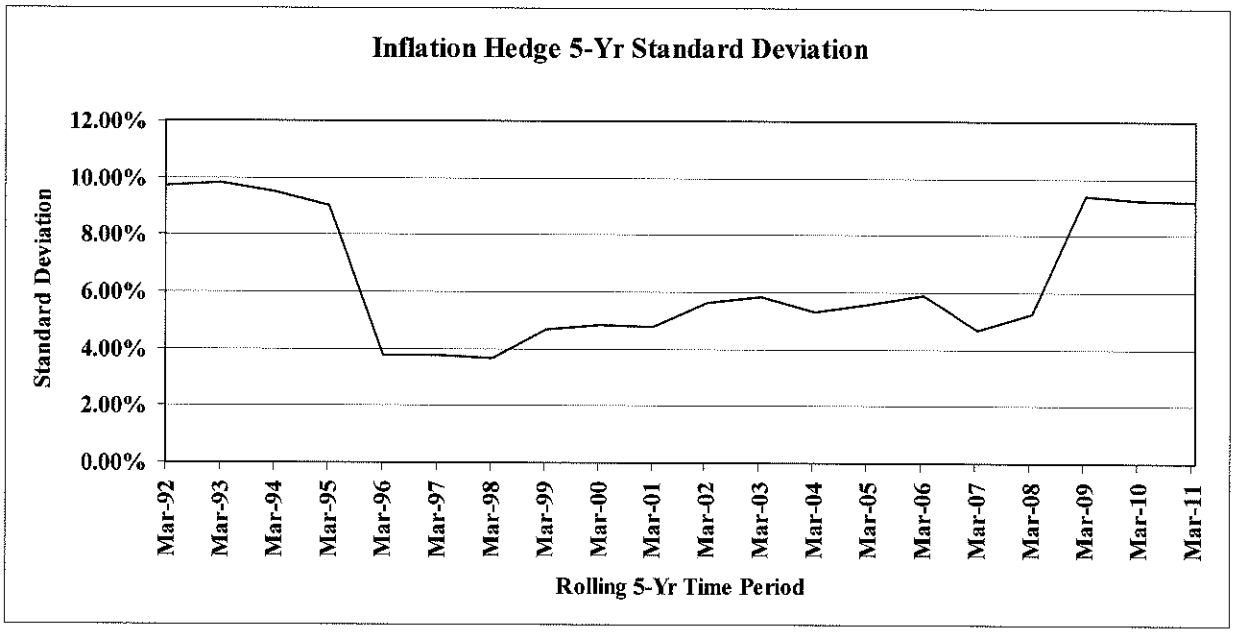
Alternative Investments

The standard deviation of private equity, as measured by the UBS Private Equity Indicator, has ranged between 3.9% and 18.3% since 1992. The standard deviation was within the range of 4.0% to 6.0% between 1992 and 1999. Between 2000 and 2003 the standard deviation climbed rapidly to its period high of 18.3%. Subsequently, the standard deviation fell rapidly to 6.3% in 2008 before climbing to 10.8% in the most recent period. We believe that a standard deviation of between 10.0% and 15.0% is likely going forward.



Inflation Hedge

The standard deviation of inflation, as measured by the custom inflation hedge index, has ranged between 3.7% and 9.8% since 1992. The standard deviation fell initially from 9.7% in early 1992 to 3.7% in 1998 before remaining relatively stable for the period between 1998 and 2008. The standard deviation climbed rapidly to 9.4% in 2009 and retained this level through 2011. We believe that a standard deviation of between 6.0%and 10.0% is likely going forward.



91-Day Treasury Bills

The risk of T-Bills, as measured by standard deviation, has been primarily in the 0.2% to 1.0% range. During the earliest rolling periods, the standard deviation reached a period high of 1.2% in 1994 before falling to 0.2% in 2000. Since 2000, the risk has climbed to 1.1% in the most recent period. We expect the risk to rise somewhat and be between 1.0% and 2.0%.