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STRATEGIC ASSET ALLOCATION AND SPENDING POLICY REVIEW PROPOSAL

NORTH DAKOTA LEGACY FUND September 28, 2012 Brian Birnbaum, CFA Partner



Agenda

- Mercer
- Mercer Investments
- Strategic Asset Allocation Approach
- Experience with Similar Plans
- Appendix
 - Original Proposal
 - Sample Work Product A
 - Sample Work Product B

Partnership for change Mercer

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- More than 25,000 clients worldwide, about 10,000 in US
- Backed by our parent company, Marsh & McLennan Companies, with 2011 revenue of almost \$11 billion
- Investments business the fastest growing segment within Mercer

Mercer Investments at a glance

Qualified, Experienced, Global Staff

Firm

- 3,000+ clients worldwide, 600+ in the US
- \$6.5 trillion in assets under advisement globally, \$1.2 trillion in the US
- \$59 billion in assets under management globally (As of June 30, 2012)
- 60+ offices worldwide
- Clients in more than 40 countries
- More than 40 years advising investors

Employees

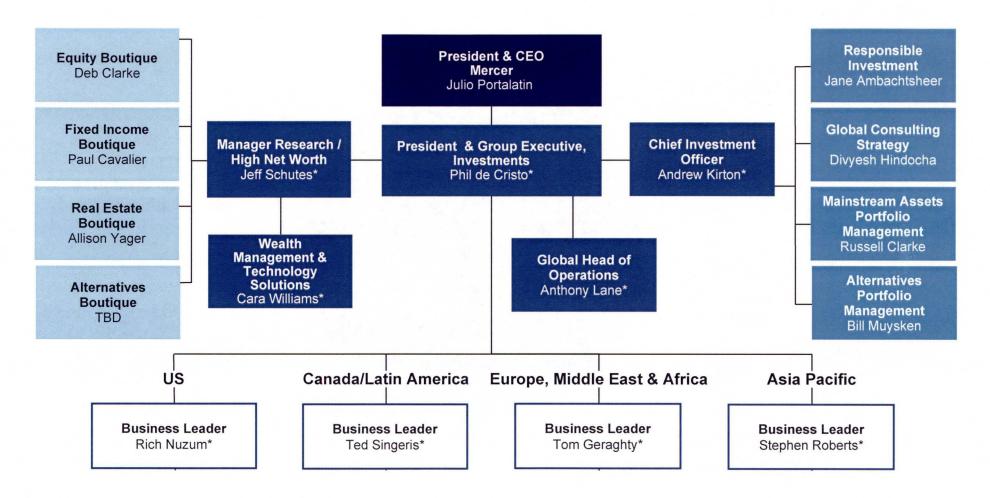
- 1,255 employees
- Consultants average 10+ years of investment experience, in 23 countries

Specialist Expertise

- Financial Strategy Group 70+ professionals providing sophisticated modeling and holistic risk management advice including strategy and implementation
- Manager Research Boutiques 100+ full-time research professionals evaluating traditional and non-traditional investment managers
- Sentinel Group investment operations consulting focusing on custody, transition management and other operational aspects
- Implemented Consulting clients seeking to outsource day to day fiduciary management and operations
- Responsible Investment team clients seeking to manage non-traditional risks such as climate change and corporate governance

Mercer Investments

Global structure



^{*} Denotes member of Global Investments Leadership Team

June 2012

Our View of the World's Asset Classes

Growth Assets

Drives long-term capital appreciation

Seeks to mitigate high return volatility through diversification and tilts to areas with attractive relative valuations.

Includes global and domestic equities – both publicly traded and privately held



Risk Reduction

Lower volatility asset classes

Helps to minimize correlation to equity returns

Includes bonds – both global and domestic – and hedge funds

Inflation Protection

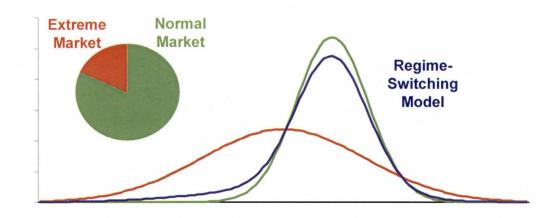
Attractive for institutions with inflation-sensitive liabilities

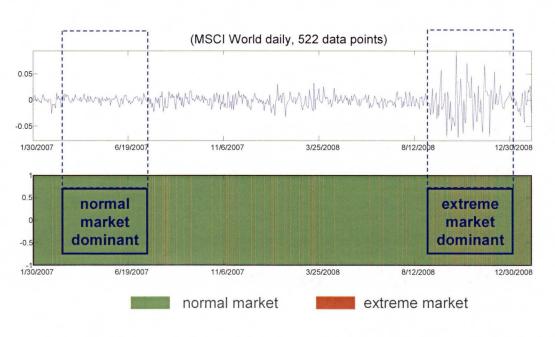
Helps to protect against unanticipated inflation

Includes Treasury Inflation
Protected Securities, natural
resources and real estate

Optimization – Capturing non-normality

- Capital market models
 - Returns are not normally distributed
 - stronger focus on downside risks
 - The behavior of returns differs in distinct market states
 - higher volatility in "stressed" markets
 - higher correlation between some asset classes in "stressed" markets
 - → Regime-Switching approach





Mercer's robust optimization approach

Standard optimization (Markowitz) has several shortcomings

- High sensitivity to input parameters
- Estimation risk
 - Limitation of optimization to parameters return and covariance, which are determined by a point estimate
- Normal distribution
 - Underestimation of tail risks

V

Robust optimization offers improvements to the traditional approach

- Consideration of estimation risks
- Regime switching approach
 - Allows modelling of skewed distributions and fat tails
 - Assumes that the market can be in several states (normal vs. crisis market regimes)
- Consideration of 'catastrophe' scenarios



Illustrative asset allocations More robust and better diversified solutions Assetsiasse 12 Assetsiasse 10 Assetsiasse 10 Assetsiasse 3 Assetsiasse 6 Assetsiasse 6 Assetsiasse 6 Assetsiasse 7 Assetsiasse 7 Assetsiasse 7 Assetsiasse 8 Assetsiasse 7 Assetsiasse 7 Assetsiasse 8 Assetsiasse 8 Assetsiasse 9 Assetsiasse 9

Risk is multi-dimensional

- To supplement risk/return analysis we seek to better understand the exposure of a portfolio to underlying return drivers
- Aim to diversify between the return drivers as opposed to simply diversifying between asset classes
- Conduct similar exercise for portfolio risk factors

Current asset allocation

Stress test candidate portfolios for robustness under different market conditions

Example: Portfolio return by return drivers

Proposed asset allocation

Other Other Non-Corporate GDP Growth Alpha 0.0% 0.0% 0.0% 13.4% Equity Risk Premium 68.9% Illiquidity Premium 1.4% Equity Risk Premium Alpha 34.7% Term Premium 38.0% 9.4% Unexpected Inflation 0.3% Credit Risk Premium 6.6% Small Cap Premium Non-Corporate GDP Grow th 0.0% Emerging Mkt Premium **Emerging Mkt Premium** 0.0% Illiquidity Premium 0.0% Credit Risk Premium 2.0% Small Cap Premium 12.2% 0.0% Term Premium Unexpected Inflation 0.1% 13.1%

Experience with large government institutions and newly established funds

- Norwegian Petroleum Fund (Norway)
- Chilean Copper Fund (Chile)
- Large Sovereign Wealth Fund (Gulf Region)
- Libyan Investment Authority (Libya)
- Banking and Payments Authority of Timor-Leste (East Timor)
- Kuwait Investment Authority (Kuwait)
- New Zealand Treasury/New Zealand Superannuation Fund (New Zealand)
- Employees Provident Fund Organization (India)

- Large State Government Superannuation Fund (Australia)
- Government Pension Fund (Asia)
- Swedish Buffer Fund (Sweden)
- Future Fund (Australia)
- Asian National Pension Fund (Asia)
- Government Pension Investment Fund (Japan)
- Fonds de Reserves des Retraites (France)

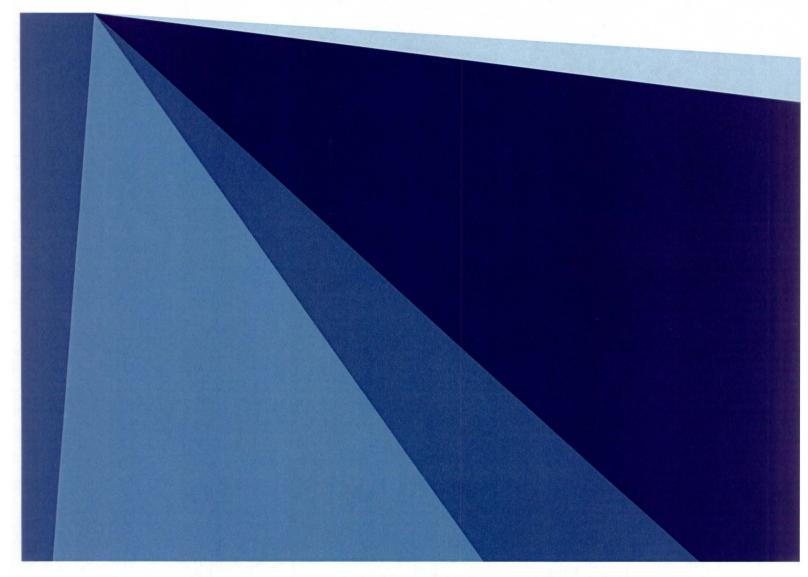




PROPOSAL FOR STRATEGIC ASSET ALLOCATION AND SPENDING POLICY REVIEW

NORTH DAKOTA LEGACY FUND

SEPTEMBER 2012





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1

Executive summary

We are delighted to have been invited to propose for a strategic asset allocation and spending policy review for the investment portfolio of North Dakota Legacy Fund ("NDLF"). We are very excited at the prospect of working on this important assignment and are pleased to submit this document for your consideration.

Mercer is uniquely qualified to assist the NDLF in this project. We are one of the largest investment consulting organisations globally and have the necessary resources, research and experience to deliver the highest level of expertise required for this critical project.

We live in unprecedented turbulent times and we believe that a successful outcome to this assignment will depend on the appointment of an investment consulting firm that has:

- Strong experience of developing SAA and spending policies in a risk controlled framework
- Scale to support proprietary, specialist research to develop penetrating insights into asset classes an specialist expertise for creating structured solutions
- Pragmatic approach to applying innovative solutions from around the world
- Team with experience of working with large government institutions, including those with natural resource-based funding sources
- Expertise in working with newly established funds, particularly those characterized by an initial investing phase, and subsequent spending phases

We are happy to provide references at your request. We have performed very similar studies for various Middle Eastern and Asian oil and gas funds and a South American metals-based fund. Importantly, many of these prior projects were similar in scope to NDLF – most were seeking asset allocation advice for their newly established funds, many of which were in investing mode with very little to no current spending requirements. We believe the analysis required for these newly established funds is fundamentally different than the analysis required for funds that have been in existence for many years.

We hope that this proposal meets with your expectations and we look forward to discussing it with you further.

Brian Birnbaum, CFA

Partner and Midwest Market Business Leader

September 14, 2012

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Proposed approach

We propose a collaborative approach between NDLF and Mercer that seeks to combine

- the knowledge and insights that NDLF staff have about the key objectives and constraints for the portfolio
- the asset class and portfolio construction expertise and experience of Mercer's world class investment capability

We propose a two phase approach to the development of a robust and practical strategic asset allocation for NDLF as follows:

Phase A – Understand the key investment objectives of the portfolio, risk tolerance and operating constraints

Phase B – Develop the opportunity set of strategic asset allocations and recommendations; model, evaluate, and recommend potential changes to current spending policy

We now describe each phase in detail.

Phase A: Understand key investment objectives, risk tolerance and operating constraints for the portfolio

The purpose of this critical phase is to ensure that the strategic asset allocation is built on a solid foundation. It is impossible to consider the strategic asset allocation without regard to NDLF's investment objectives, risk tolerance and operating constraints.

We will focus intensively to understand from NDLF staff the key parameters within which the portfolio needs to be managed and how you see them evolving over the coming years. Understanding the strategic thinking behind the projected evolution of NDLF's requirements from the portfolio is important in ensuring that the asset allocation provides the required balance between liquidity, security/stability and return generation on a medium to long term view.

We shall need to understand the overall cash flows of the NDLF and the key strategic issues relating to the portfolio, including

- What is the rationale for holding the reserves and background to current strategic asset allocation
- What is the size of potential spending relating to the portfolio? What are the nature and factors that affect this spending, and what is the potential correlation of spending and fund deposits/spot oil prices?
- What is the potential sensitivity of optimal asset allocation to evolving spending policies?
- What are the liquidity requirements and how are they expected to evolve?
- What is the anticipated cash flow profile and how can this change?

- Views on security and circumstances when negative absolute returns can be tolerated, if any.
- How much fluctuations in returns can be tolerated
- Which asset classes/instruments are currently used in the portfolio? Are there any legal or other restrictions on use of other asset classes/instruments?

NDLF is a significant and unique institution, particularly in the United States. As a result, we believe that it is important to identify its natural competitive advantages so that the strategic asset allocation can capitalize on them. For example, the global financial crisis has weakened the balance sheets of many institutions and they are being forced into transactions that distort the true value of assets. In this situation, the investment phase of NDLF and the current requirement of a super-majority vote to initiate any spending post 2017 may give it a competitive advantage that can be reflected in its strategic asset allocation. Furthermore, a fund growing at approximately \$50 million per month may have the ability to lock up a larger proportion of capital in seeking higher investment returns than another fund the does not enjoy the same cash flow profile.

We anticipate that our discussions with representatives of NDLF and review of documents/reports during this phase will give us a good understanding of

- the key objectives to be met by the portfolio in terms of liquidity, security, returns etc and their priority
- eligible assets/instruments and type of risks that may be tolerated
- the investment decision making structure and capacity
- operating constraints and any natural competitive advantages

We shall document our understanding and agree it with NDLF before progressing to Phase B. At this stage it will be clear if we need to divide the portfolio into tranches.

Phase B – Develop the opportunity set of strategic asset allocations and recommendations; model, evaluate, and recommend potential changes to current spending policy

The development of the strategic asset allocation will be driven from the output of Phase A, which will define the key requirements that the portfolio has to meet and their priority. This critical link aims to ensure that the strategic asset allocation is grounded in NDLF's investment objectives, tolerance to risk, and operating constraints. In conjunction, the NDLF's SAA will be driven by its ultimate spending needs/requirements. The current spending policy requires a super-majority vote to require any spending post 2017. As a result, the current spending policy results in a highly uncertain spending need for the fund. We will test our asset allocation recommendations against alternative spending policies, those that are more traditional (i.e., based on a percent of market value) and those that are adjusted relative to the rate of inflation. Our goal is to not only ensure that the SAA for the NDLF is appropriate given evolving spending needs, but to also ensure that the NDLF lives up to its primary objective – providing sources of funding for future generations of North Dakotans.

Depending on the outcome of phase A, it may be necessary to split the portfolio into different tranches and develop a strategic asset allocation for each tranche with associated benchmarks.

This approach avoids one of the main failings revealed by the recent financial crisis as institution after institution ran into difficulties because asset portfolios had spun out of control in terms of liquidity, duration, economic sensitivity, etc. This is not to say that there should not be any mismatching but that any mismatching should be controlled with a clear 'safe harbor' reference point and a measured approach as to any deviation.

Against this background, we recommend an approach which is a judicious mix of art and science for the development of the strategic asset allocation. We believe that history has many lessons for an investor but we also believe that strategic asset allocation should be formulated with a forward looking mind-set. This is especially true in the current environment where the global economy and financial system remain fragile and significant imbalances and power shifts need to be managed.

The key developments being:

- It is now well understood by most investors that we are in a midst of some fundamental changes. The "super-debt" cycle is at an end, bringing in its wake some major challenges for policy-makers and politicians.
- Prospects for economic growth have to contend with the gravitational force of de-leveraging with the one positive being the continued growth and wealth creation in "developing" countries.
- Unconventional policy measures and concerns about entering into a prolonged deflationary period have taken bond yields to very low levels, with in some case real yields being negative.
- The Euro-zone continues to be a source of systemic risk which is weighting down on many risk assets.

In such conditions, it is important to take a multi-dimensional approach to development of the strategic asset allocation. We understand the limitations of statistical modeling and use such techniques selectively to help test our judgmental thinking as opposed to using mathematical analysis to drive the strategic asset allocation in the belief that it is possible to reduce the real world dynamics into a model. Later in this section we discuss in more detail some of the specific analysis that we anticipate will be required.

The key steps in this phase will be as follows:

- 1. Asset class analysis (identify full universe of eligible asset classes and their characteristics)
- 2. Evaluation of the current portfolio
- 3. Consideration of candidate portfolios
- 4. Evaluation of current and alternative spending policies
- 5. Strategic asset allocation recommendation and investment policy statement

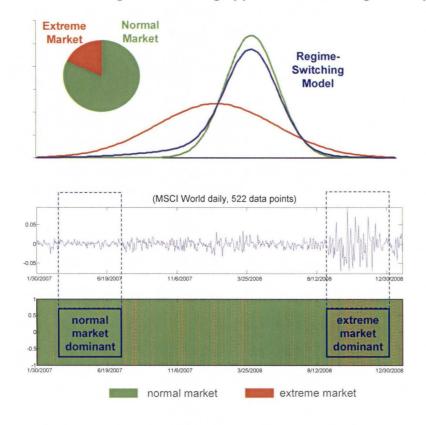
We have highlighted below some of the issues that will be considered as we go through the above steps:

1. Asset class analysis

Asset classes are the building blocks of a portfolio and the relative exposure of a portfolio to different asset classes will determine the behavior of that portfolio under different conditions. It is therefore critical to form a view on the characteristics of the asset classes that are included in the current portfolio as well as others that are eligible. We will agree with NDLF the asset class opportunity set to be considered for this analysis.

We will propose forward-looking assumptions for expected return and distribution of those returns for the eligible asset classes for discussion and agreement with NDLF. We are conscious that financial returns do not neatly fit the convenient normal distribution pattern assumed within many models. A noticeable feature of asset class return behavior is the increase in correlations of returns during bear markets and market crises. Such market crises have raised awareness of the fat-tailed nature of asset returns and these distributions are seen as more appropriate in the modeling of future investment returns and risks. To allow for fat tails we adopt a regime-switching approach where individual asset class returns are assumed to be generated from two distinct distributions (representing "regular" and "extreme" market conditions) which are combined to generate a fat-tailed distribution. Assumptions for the fat-tailed distribution would be incorporated into our forward looking capital market views.

Illustration: Basic regime-switching approach based on global equity returns



It will also be necessary for us to characterize each asset class by factors that are relevant to the NDLF's requirements identified in Phase A. For example, in order to assess the real liquidity of a portfolio a qualitative assessment will be required about the liquidity characteristics of each underlying asset class. We shall work collaboratively with NDLF to agree an appropriate score for liquidity (and other relevant factors) for each asset class.

2. Evaluation of current portfolio

Based on characteristics of asset classes agreed with NDLF, we shall evaluate the current portfolio in relation to the requirements identified in Phase A. This will show the extent to which the current portfolio meets the requirements that are relevant for NDLF. Considering the current portfolio in these terms will allow us to consider the implications of any areas of misfit and discuss with NDLF the priorities for any corrective action.

3. Consideration of candidate portfolios

Traditional optimization models suffer from various simplifying assumptions (i.e., estimation error of assumptions, normal distributions, static correlations, etc) and require either highly manual constraints, limited the usefulness of the results, or result in undiversified portfolios.

Candidate portfolios would be analyzed in relation to the efficient frontier on a more conventional risk/return basis. However, results using the traditional Markowitz methods are often poorly diversified and non-intuitive. Unless constrained or "hand polished", they do not fulfill the basic goal of spreading risks among a wide range of risk and return sources. We therefore propose to use a Robust Optimization approach, parameter estimation is allowed for explicitly in determining optimal allocations. This results in portfolios that are much better diversified with intuitive appeal as shown below.

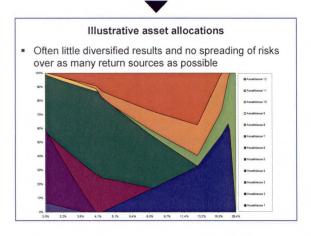
Illustration: Robust optimization approach versus traditional Markowitz approach

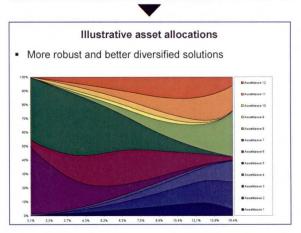
Standard optimization (Markowitz) has several shortcomings

- · High sensitivity to input parameters
- Estimation risk
 - Limitation of optimization to parameters return and covariance, which are determined by a point estimate
- Normal distribution
 - Underestimation of tail risks

Robust optimization offers improvements to the traditional approach

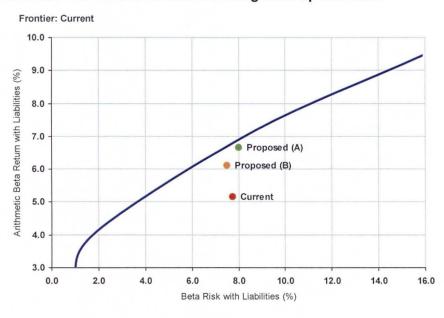
- Consideration of estimation risks
- · Regime switching approach
- Allows modelling of skewed distributions and fat tails
- Assumes that the market can be in several states (normal vs. crisis market regimes)
- Consideration of 'catastrophe' scenarios





Versus the standard approach, Mercer's robust optimization approach copes with estimation risk of parameters and non-normality of investment returns to build portfolios that are more robust to changing market conditions. Resulting from the optimization approach it is possible to plot the efficient frontier and evaluate potential portfolios versus theoretical optimal allocations.

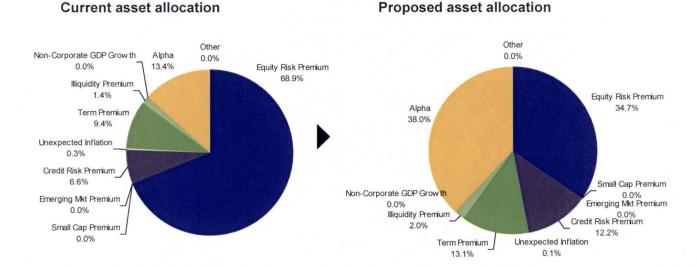
Illustration: Efficient frontier resulting from optimization



Volatility of returns is not a complete measure of risk and in the aftermath of the recent financial crisis, investors are now attuned to a broader sense of risk. Risk is a multi-dimensional concept and Mercer believes a thorough understanding of all of the risks attached to a portfolio is required to properly consider it.

Therefore, as a supplement to the risk/return analysis we seek to better understand the exposure of a portfolio to the underlying return drivers, and to aim to diversify between the return drivers as opposed to simply diversifying between asset classes. A similar analysis would be carried out looking at the breakdown of portfolio risk.

Example: Portfolio return by return drivers



In addition to the above, further analysis will be carried out to stress test candidate portfolios for robustness under different market conditions.

4. Strategic asset allocation recommendations

Finally, we would discuss the current portfolio, the candidate portfolios and comprehensive supporting analysis and receive feedback for any fine tuning required before finalizing our recommendation that would set out recommended portfolio. We believe this process will be highly iterative, requiring additional analysis, before a formal recommendation is advanced.

3

Fees

We are prepared to dedicate the necessary resources required to complete this project by year's end. Our ability to complete the project in this timeframe, however, will also depend upon the NDLF's timely contracting process and ability to dedicate significant time to ongoing discussions related to our analysis.

Our proposed all-inclusive fee for the project is \$110,000. The fees would be payable in two instalments, 50% after completion of Phase A of this project, and the remainder after issue of the final report.

4

Team structure and members

We propose a team structure and membership that aims to apply the full force of Mercer's global intellectual capital and experience in working with similar organizations seeking assistance in the development of a strategic investment strategy.

We propose Brian Birnbaum as the lead consultant and Rich Nuzum as the Executive Sponsor for our work with the NDLF. Brian is a Partner and Midwest Market Business Leader for Mercer's Investments practice, and is an 18 year veteran in the investments industry, having worked with some of the largest public retirement systems in the United States on issues related to strategic asset allocation, portfolio structure, manager selection and program monitoring. Brian also has deep experience in working with public endowment assets, similar in character as the NDLF. Rich is a Senior Partner and Head of Mercer's Investments practice in the United States. Rich also has deep experience in working with a number of sovereign wealth funds, including those whose funding were based on natural resource production. Their bios are listed below.

Brian J. Birnbaum, CFA

Partner, Mercer Investment Consulting

Brian is a partner and head of Mercer's investment consulting practice in the Midwest region. He assists institutional investors with the development of investment policies and objectives, the evaluation and selection of investment managers, and the measurement and analysis of performance results.

Prior to joining Mercer, Brian was the Director and Head of Credit Suisse's institutional consulting arm, Investment Management Consulting Services. Before joining Credit Suisse, Brian was a principal with Ennis Knupp & Associates and a senior consultant to a number of public retirement system, corporate pension, private foundation and high net worth clients. Brian also led the firm's effort in US equity and fixed income manager research. In addition, he has authored a number of technical papers and was a frequent speaker at conferences on topics ranging from risk management to pension fund best practices. Brian's investment management experience includes time with Aon Advisors, where he managed fixed income portfolios, performed equity analysis and implemented derivative strategies. He has over fifteen years in institutional investment consulting and investment management roles.

Brian received his Bachelors in Business Administration in Finance from Loyola University Chicago. He is a CFA charterholder and is a member of the Investment Analysts Society of Chicago and the CFA® Institute.

Rich Nuzum, CFA

Senior Partner, Mercer Investment Management

Based in New York, Rich leads Mercer's investments business in the United States. Before taking on his current role, Rich was Global Business Leader for Mercer's investment management business from 2008 through 2011, Americas Business Leader for Mercer's investment consulting business from 2005 to 2008, and Asian Business Leader for Mercer's investment consulting business from 1997 through 2005.

During more than 20 years with Mercer, Rich's investment consulting clients have included corporate and public defined benefit and defined contribution plan sponsors, not-for-profit healthcare systems, foundations, endowments, insurance companies, sovereign wealth funds and central banks. Rich has worked with clients in more than 15 countries, and has provided investment consulting advice to more than a dozen of the world's 100 largest institutional investors.

Rich holds an MBA with High Honors in Analytic Finance and Accounting from the University of Chicago, and a BA with Honors in Mathematical Sciences and Mathematical Economic Analysis from Rice University. Before joining Mercer, Rich did graduate work in international economics at Tokyo University. Rich is a Chartered Financial Analyst and a member of the CFA Institute.

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August 2003

Norwegian Petroleum Fund Investment Strategy Proposal

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Summary

Executive Summary

Financial markets are generally believed to offer investors increasing expected returns for increasing levels of (non diversifiable) investment risk. Strategic asset allocation for an institution involves choosing, from the various alternatives offered by these markets, the trade off between risk and return that is appropriate in terms of the objectives of the institution and the interests of the parties involved.

Once this choice is made, in practical terms, strategic asset allocation serves only as a *benchmark* to measure the management of the Fund. Decisions as to whether markets should be over or under weighted should be taken by management relative to this benchmark. This report does not take any views on the relative valuation of global markets. The issue of tactical asset allocation is beyond the scope of this report.

We begin by discussing a range of different approaches to setting strategic asset allocation. We see a number of important drawbacks in what has become the established method of addressing strategic asset allocation questions, namely the use of "long-term" models. The application of normative economic theories could provide an alternative, but are inconsistent with the stated objectives of the Fund. We have therefore turned to what may be called "Representative Investor" methods. We make a case, accepting some of the practical limitations, for the use of a global market capitalisation-weighted benchmark as the natural model portfolio for investment in global financial assets.

The liabilities of the Fund are not explicitly defined. One objective for the Fund, set out in 1997, made reference to the maintenance of value in terms of international purchasing power. In these terms, a portfolio of inflation-linked government bonds with duration equivalent to that of the Fund would minimise risk. We show, however, that on the assumption of a 25 year duration for the Fund, the available durations of bonds within inflation-linked markets around the world, combined with the fact that such bonds are not available in all currencies, means that material risk remains even under the "least risk" strategy.

Our central proposal is that the Fund should adopt a core portfolio managed to a market capitalisation benchmark of global assets. This benchmark currently implies around 50% (slightly more) in global equity markets and 50% in other assets (predominantly global investment grade bonds). We recommend that the currency exposure of the core portfolio should follow that of the assets comprising the market capitalisation benchmark.

The definition of the acceptable level of risk in the fund is unclear. If the level of equity exposure in the market capitalised benchmark is considered to be excessive then we recommend that this should form the "core" portfolio benchmark and a separate least risk

satellite portfolio should be constructed to mitigate risk.. To maintain equity exposure at levels broadly equivalent to the current strategy, a 75% allocation to the core portfolio and 25% to the satellite would be needed. However, we demonstrate that the overall difference in risk between the current strategy and the core market capitalisation weighted portfolio (without any satellite allocation) is relatively modest given the overall uncertainty in the Fund's liabilities and the definition of acceptable risk.

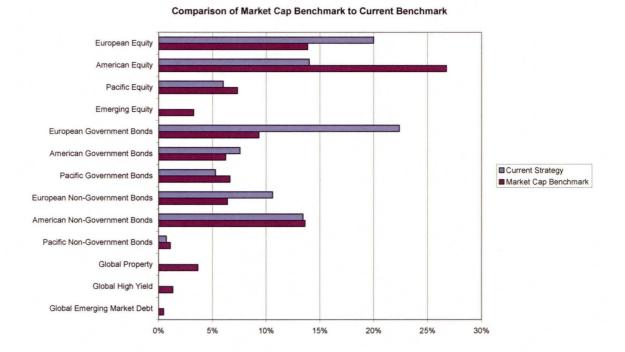
The global market capitalisation benchmark includes an allocation to small cap equities, real estate, emerging market sovereign debt, global high yield debt and private equity. In none of these asset classes do we consider it reasonable to expected abnormally high returns (in other words, greater than bonds and equities on a risk-adjusted basis). Their place in the strategy is justified if they offer a meaningful contribution to overall portfolio diversification.

Our analysis indicates that, although optimal in the purest sense, inclusion of emerging market debt and high yield, together with some equity small cap markets at their market capitalisation weights will have only a marginal impact upon overall expected return and risk. The case for including small cap allocations in the main equity markets (US, Europe and Japan) and Global Real Estate appears stronger on diversification grounds.

Given the absence of reliable data on private equity, this must be dealt with largely qualitatively. The potential difficulties in gaining initial exposure and subsequently managing it, in particular in terms of the general aim of operating the Fund on a transparent basis, would tend to argue against its inclusion in practice.

Inflation linked bonds will also in our opinion offer no material benefit when included at their market capitalised weight in a global benchmark. These bonds should be included only if a separate low risk "satellite" portfolio is constructed. This portfolio should adopt trade weighted currency exposures and invest in inflation linked bonds in economies where these are available. Constraints imposed by the size of the global inflation-linked bond market would argue against an allocation of more than 3% to any one inflation linked market. In other economies, or if the 3% limit on inflation linked exposure is exceeded, the satellite fund should invest in short to medium (10 year) maturity bonds. However, in view of the practical constraints preventing the Fund from investing in closely matched inflation linked bonds, we show that this satellite portfolio does not materially reduce risk relative to adopting the core market capitalised benchmark for the entire portfolio.

The chart below compares the current strategy to the market capitalisation portfolio:



In summary, the primary differences between our proposal and the current Fund strategy are;

- a higher overall equity allocation (by around 10% of the Fund) and correspondingly lower bond allocation;
- a greater bias to the US market, with a commensurately lower allocation to European markets;
- a more diversified benchmark within equity that includes smaller capitalisation stocks;
- an allocation to global real estate.

We have noted that the quantitative case for real estate is mitigated by the practicalities of easily accessing a diversified global exposure. The strictest interpretation of the market capitalisation portfolio would also see allocations to private equity, high yield and emerging market debt, but our analysis suggests that these asset classes offer only modest benefits in risk/return terms to the aggregate portfolio and practical considerations may favour their exclusion (practical considerations may also be a constraint on real estate investment as discussed in section 6.12 of the report).

Although we appear to have approached this review from a different angle when compared with previous studies, it should perhaps be noted that the above differences are

in our view relatively minor when seen in the overall context of the asset allocation for this Fund. There are also very important similarities between our conclusions and earlier studies, despite the apparent difference in approach. In particular;

- Both approaches involve a trade off between risk and return; neither involves
 minimising risk as an over arching objective. Even without the inclusion of the
 satellite portfolio to equate equity exposures, the basic risk and return trade off is
 rather similar between the two strategies (in the context of the much wider range
 of alternative possibilities).
- Both approaches use broad market capitalised market indices within individual
 asset categories to achieve diversification (our proposal merely extends this
 approach to the weights given to asset categories also).

Furthermore, some of the detailed changes (such as inclusion of real estate and small capitalisation stocks) have already been discussed positively as possibilities for the Fund. Thus our review should be seen as arriving, by different means, at conclusions that are broadly consistent with current policy and our proposals should in our view be seen as evolutionary rather than requiring fundamental change of policy.

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A. Table of Covariance Matrix

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Introduction

- 1.1 The work on which this paper reports was commissioned by and is prepared in accordance with a contract with the Norwegian Ministry of Finance (the Ministry). The terms of reference for this work are set out in the Invitation to Tender issued by the Ministry to Mercer Investment Consulting (formerly known as William M Mercer Limited) on 13th May 2002.
- 1.2 The Requirement Specification described in the Public Procurement Basis states that:

"The choice of asset allocation in the portfolio is a fundamental investment strategy issue and will be the main theme of the report. More specifically, the report must focus on different consequences of a possible change in the mix between equities and fixed income, a change in the benchmarks and the inclusion of new investment alternatives, for instance index linked (inflation protected bonds), private equities and real estate (commodities and hedge funds are not relevant)"

1.3 This report is addressed to the Ministry and presents formally the results of the work undertaken over the intervening year. The direction and focus of the work has evolved somewhat over time. Thus although our report covers all of the issues described in the above specification, certain issues have been raised to greater prominence (and others accordingly de-emphasised), to reflect our recommended approach to the fundamental investment strategy issue.

Jon Exley and Stephen Woodcock For and on behalf of Mercer Investment Consulting 2

Approaches to Setting Strategic Asset Allocation

Background

- 2.1 Financial markets are generally believed to offer investors increasing expected returns for increasing levels of (non diversifiable) investment risk. Strategic asset allocation for an institution involves choosing, from the various alternatives offered by these markets, the trade off between risk and return that is appropriate in terms of the objectives of the institution and the interests of the parties involved.
- 2.2 In practical terms, once established, the strategic asset allocation is then simply a benchmark against which the management decisions of the Fund can be measured. Thus, for example, if those responsible for the management of the Petroleum Fund have a view that, say, it should be underweight in US equities, the benchmark measures what we mean by "underweight". We mean underweight relative to the benchmark, as under or over weighting only has meaning in relative terms.
- 2.3 The actual returns earned on financial assets are of course beyond the control of investors, institutional or otherwise. One may wish to take views on whether certain financial markets offer abnormally high or low returns at the present time by reference to the risk and return trade off assumed for markets generally. However, such views fall beyond the scope of this report. An additional layer of management is required to make such decisions.
- 2.4 Since a departure from a long term trend can correct at any time, it is in fact difficult to distinguish between "long term" and "short term" views in any event. The additional layer of management required to make such decisions can thus be called tactical asset allocation or medium term strategy, but the important point is that all of the layers of management need to be measured against something, namely a benchmark¹.

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¹ Some of the large Metropolitan local authority pension funds in the UK successfully adopt this additional tier of asset allocation management approach through the role of investment committees comprising (paid) advisers drawn from fund management and other investment industry sources. The tiered approach is also followed to a lesser extent by a small number of other large UK pension plans, although the freedom to take such active medium term asset allocation decisions is often stifled by the Trust status of these funds (which differs from the legal status of local authority funds). A similar approach is also adopted widely by insurance companies. In summary the UK experience seems to be that this approach is practical provided that responsibilities are clear (which is not the case for Trust based arrangements).

2.5 The role of the strategic asset allocation as defining a risk and return trade off and the view of strategy in practical terms as merely a benchmark reflect a more limited ambition than some previous aspirations of "strategic" asset allocations. The development of modern thinking on this issue is described further below.

The Development of Modern Approaches to Asset Allocation Benchmarks

2.6 The formulation of modern strategic asset allocation advice to institutions has undergone a substantial change in recent years. The failings of model—based approaches have led increasing numbers of practitioners towards approaches based on normative financial economic theory. Here, the role of modelling is subordinated below some over arching rationale for a particular approach (such as close hedging) rather than to determine a risk and return trade off in a classical portfolio selection framework. We describe below the differences between the two by way of an introduction to the review.

The "Long Term Model"-Based Approach

- 2.7 The model based approach grew out of the freedom created by modern computing power that enabled the application of statistical analysis to large volumes of data and the building of complex simulation models.
- 2.8 By the early 1990s all of the major Investment Consulting firms had their own proprietary model. Mercer Investment Consulting developed such a model in 1990 and the Mercer Global Capital Market Simulator is still widely used by pension funds, especially in the United States and the Netherlands.
- 2.9 These models all postulate relationships between various macro economic factors, asset yields and asset returns that are fitted to past data using standard statistical estimation techniques. The models are then used to simulate the development of asset portfolios, often relative to simulated liabilities, over very long horizons (twenty years).

Criticisms of the Model Based Approach

- 2.10 By the mid 1990s it had become apparent that these models did not necessarily provide robust answers to the problems that they were designed to solve:
 - i. Results are highly sensitive to expected return assumptions and robust methods of deriving these to within the tolerances required for asset allocation do not yet exist (aside from the "reverse engineering" adopted in this report but this takes a representative asset allocation as a starting point).
 - ii. The apparent sophistication of models often relies heavily on supposed artefacts of data such as "mean reversion" and yet modern research

suggests that such features could be observed even in random data. Quoting from the abstract of Engstrom (Draft, 2002)²:

"...within a very general class of theoretical models, predictability regressions may be badly misspecified. In particular they have almost no power against the specific form of predictability suggested by reasonable treatments of risk. Additionally, simple predictive regressions produce estimates of the conditional risk premium which may be very different from the true values."

The basic problem with the alleged statistical significance of these mean reverting effects is that often both the explained variable (the next period return) and the explanatory variable (dividend yield, price/earnings yields, lagged returns etc) include a lagged endogenous variable (price). The importance of this violation of the condition for standard tests of statistical inference is not an easy concept to explain³ (hence the relatively modern discovery of the issue) nor is it possible in general to derive an explicit formula for the bias it introduces. However, the effect can be uncovered by out of sample testing or by simulating the same regression for data known to be free of the effects being studied. For example, it can be shown that there is a relatively high probability of observing apparent mean reversion of equity yields in sample paths generated from simulation models known to have no mean reversion⁴. Another important criticism of assumed mean reversion in models is that although it does indeed justify a relatively minor bias towards more risky assets for long horizon investors, the main conclusion is that investors should use the apparent predictability of returns to change their policy dynamically. The latter approach will often in such models appear to generate large risk adjusted returns well in excess of those from fixed policies. Explaining why these returns cannot be earned in practice is a challenge for such models.

iii. The finance literature focuses mainly on positive rather than normative economic theory and gives little confidence in the ability of models to *predict* individuals' portfolio preferences. There is extensive literature on the "time diversification fallacy" which shows that intuitive beliefs about the way asset allocation preferences change with time horizon are often

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² A good summary of the modern criticisms of once widely held belief that the equity dividend price ratio is a simple mean reverting process is provided in "The Conditional Relationship Between the Equity Risk Premium and the Dividend Price Ratio" by E. Engstrom (Draft, November 2002) on http://www.gsb.columbia.edu/doctoral/students/job/ee68_dis.pdf. This refers back to the original work by C.R. Nelson & M.J.Kim "Predictable Stock Returns: The Role of Small Sample Bias" in Journal of Finance 48,2,641-661.

³ A more general and shorter discussion of the biases in models is provided in "Avoiding biases in TAA Model Building" by L.Chaumeton & G.Connor on http://www.barra.com/Newsletter/NL163/ TAAModNL163.asp

⁴ See "Mean Reversion and Market Predictability" by Jon Exley, Andrew Smith and Tom Wright, presented to the Finance and Investment Conference of the Actuarial Profession, June 2002.

fallacious. Quoting from the conclusion of the second chapter of Campbell & Viceira ⁵

"Does the investment horizon affect portfolio choice? ...we have shown that it may not. We have assumed that investors' relative risk aversion does not depend systematically on their wealth...Under this assumption, the investment horizon is irrelevant for investors who have only financial wealth and who face constant investment opportunities....Popular arguments,..., such as the claim that long term investors can afford to take greater risk because they have 'time to ride out the ups and down of the market', are simply wrong under these conditions'.

- iv. It is important to note that this does not rule out time horizon effects in portfolio choice, but it does dismiss intuitive reasoning behind these effects. For example it is not sufficient simply to point to the reduced probability of loss as time horizon increases. Despite this reduction in loss probability, the result referred to by Campbell & Viceira still proves that under some plausible investor assumptions, there would be no impact of time horizon on portfolio choice. The explanation for this is that although the intuitive analysis picks up the reduced probability of moderate losses, it does not pick up the increased probability of extreme losses along paths with repeated market falls. It is possible to construct models which show some time horizon effects, but they require more complexity and the horizon effect depends on the choice of parameters (e.g. mean reversion assumptions, see above) that are open to debate.
- v. The use of arbitrary investment objectives, such as those based on arbitrary percentile outcomes, give arbitrary answers and, as discussed above, can mask important effects such as increased probability of extreme loss. This is well described by Norges Bank in "An Analysis of the Government Petroleum Fund Equity Allocation" (15 March 2001).

"A common argument for increasing the equity proportion when the investment horizon is longer is the reduced probability that equities perform less favourably than alternative investments (shortfall risk falls). However, it is not sufficient to focus on the probability of a lower return on equities. It is important to consider how much lower the return on equities may be. Even though the probability of a lower return is reduced when the horizon is extended, the size of any lower return will increase"

Although assumptions in chosen utility functions such as "constant relative risk aversion" can be queried (see item iii above), the fact that plausible utility functions such as this can give very different answers from those

⁵ See "Strategic Asset Allocation" by J.Y.Campbell & L.M.Viceira (2002).

obtained by use of arbitrary implied investor utilities should give cause for concern.

vi. Corporate financial theory argues that portfolio selection for institutions is fundamentally different from portfolio selection applied to an individual in any event. We discuss this further below.

In summary, although there is vast financial literature on the subject of portfolio selection most of the theory is essentially positive rather than normative. The existence or otherwise of time horizon effects is open to debate, but there is general agreement that intuitive beliefs about long term investors being able to "ride out the ups and down of the market" are simply wrong under some plausible assumptions. These assumptions do not remove the possibility of time horizon effects but do provide a "counter example" to disprove commonplace reasoning. Despite the attempts by practitioners to construct sophisticated long term models of asset classes, experience shows that these models do not arrive at robust recommendations (i.e. they are generally quite heavily parameter dependent, and it is difficult to determine the parameters precisely).

Approaches based on Normative Economic Theory

- 2.11 The theory reflected in (5) above is that conventional portfolio selection theory can only be applied at the level of individuals who ultimately bear the risks of institutional investment. Thus for a company pension fund, for example, we must track through the economics to identify who bears the investment risk (this might for example be shareholders or other individuals).
- 2.12 An adaptation of the Modigliani & Miller (1958) proposition suggests that these end investors are first order indifferent to the allocation of institutional assets to which they are exposed (on the grounds that they can in principle offset any institutional asset allocation by their choice of personal portfolio).
- 2.13 Second order issues (such as tax and frictional costs) are then the principal determinants of preferred institutional asset allocation. Essentially these second order issues determine how the choice of asset allocation of the institution can be used to maximise economic wealth. Modelling may be used to convert the theory into an actual benchmark (for example to determine a hedge portfolio), but the modelling required for such analysis will tend to be more subtle and sophisticated than conventional "risk versus return" portfolio selection (for example the modelling may adopt risk neutral assumptions).
- 2.14 The recent move by the £2.3bn Boots pension fund in the UK to 100% bond investment was an example of this approach. The primary decision to invest

- 100% in bonds was not based on modelling⁶. Supporters of the application of such normative theory explain the discrepancy seen elsewhere between observed institutional asset allocations and their theory in terms of principal-agent conflicts.
- 2.15 In the case of the Norwegian Petroleum Fund, the macro economic analogy of the theory used to support the simple matching of institutional assets and liabilities would be Ricardian equivalence. Under this theory, individuals would be assumed to have a strong bequest motive and behave rationally in such a way that the choice of Government policy in terms of both the decision to reduce taxes or set aside a fund, and the asset allocation of any fund, will have little impact on the economy. In this framework any Fund objectives would focus on minimising frictional costs and maximising transparency rather than a model based risk and return trade off.
- 2.16 However, it appears to be axiomatic that in creating the State fund, rather than reduce taxes, the objectives of the fund must extend beyond the minimisation of transaction costs, otherwise the Government would simply have reduced taxes. The starting point for the non-Ricardian approach is that the Government cares about the intertemporal allocation of the benefits of North Sea Oil and that it takes the view that not all consumers care about future generations.
- 2.17 It would appear therefore that the simplifications of the prescriptive theoretical approaches are not fully applicable to the Fund. Instead, the Fund's asset allocation must take account of the stated objectives of the Government, as decision-making agents, and their implied risk tolerances (again as agents rather than principals).

Representative Investor Approaches

- 2.18 In the absence of normative portfolio selection theory the most robust approaches to asset allocation tend to fall back on representative investor approaches.
- 2.19 These approaches start with the asset allocation of representative investors derived from actual asset allocation positions and then adjusts this position to allow for features of the particular investor(s) that make their situation different from that of the representative investor. The widespread references to the activities of other large institutions (CalPERS, OTPP, ABP etc) in the literature discussing the Fund's investment decisions is an example of an informal application of this approach.

⁶ See for example http://www.gemstudy.com/defined benefit pensions.htm

Conclusions

- 2.20 Before relying on sophisticated long term modelling of the Petroleum Fund to set asset allocation it is important to ask two key questions:
 - vii. In what sense is the fund long term, relative to other investors?
 - viii. Even if it is long term, how reliable is the *normative* economic theory that quantifies how this long termism should impact on investment policy?

To the extent that the Fund is ultimately owned by Norwegian citizens (even if it is held on behalf of future generations, political control rests with current generations through the democratic process) the hurdle in (i) is not trivial. It could be argued that in economic terms the fund is no more long term than a typical representative Norwegian citizen. However, even if the Fund is dealt with in economically abstract terms as "belonging" to unborn generations with a long time horizon, the hurdle in (ii) remains to be overcome.

- 2.21 In our consideration of (ii), it is important to stress that we are not ruling out the possibility that time horizon could impact on portfolio choice, but we *are* ruling out any simple and widely accepted model for this behaviour. The issue is highly contentious (and parameter or model dependent) in the financial literature. In recent years there has even been back tracking on the general consensus on long term market modelling attributes (such as mean reversion) that once seemed to provide some rationale for time horizon effects (albeit still with difficulties in deriving conclusions from equilibrium models that displayed mean reversion).
- 2.22 Thus the main question we pose is *not* whether models can be built which purport to show prescriptive asset allocation solutions for the Fund they can. The question is whether in practical terms the results of such models can be robust or reliable when compared with alternative approaches (such as representative investor comparison). Even if it were possible to construct reliable long term models of financial markets, the ability of portfolio selection theory to deliver a prescriptive solution is severely limited. The vast academic literature on this subject tends to explain observed behaviour rather than prescribe it.
- 2.23 Prescriptive solutions are offered by certain applications of financial theory that rely on first order indifference and thus fall outside conventional portfolio selection principles. However, these appear to be of only limited relevance to the Fund.
- 2.24 In the absence of prescriptive solutions, our firm opinion is that techniques based on representative investor behaviour provide the most robust approach. In practice any model based on positive economic theory tends to produce very similar results when compared with representative investor approaches in any

- event. This is because positive theories must be calibrated against representative investor behaviour in the first place.
- 2.25 In the next section we will review the objectives of the Fund. In the subsequent section we will then propose a strategy based on a slightly more formal application of the representative investor approach that appears to meet the main objectives of the Fund and is broadly consistent with existing risk tolerances implicit in the decisions taken to date by Government.

3

Objectives of the Fund and Proposed Representative Investor Benchmark

Objectives

3.1 The Ministry of Finance stated the following in the discussion of the Revised National Budget for 1997:

"In principle, the **objective** of the management of the Fund should be to invest the capital so that the Fund's international purchasing power is as high as possible at the time when it is likely that we will have to draw on the Fund, taking due account of an acceptable risk exposure. Overriding emphasis should be placed on the risk linked to the value of the Fund at the time that capital is to be drawn from the Fund. The risk that the Fund's returns will vary from one year to the next is of less importance in this connection".

The construction of this objective, if taken as read, gives only limited guidance. The reference to international purchasing power must logically be associated with the risk constraint, and not with the "as high as possible" return. (Whichever strategy maximises return will also maximise international purchasing power, making the reference to purchasing power redundant in the context of achieving the "high as possible" fund). Instead, we would thus read the objective as meaning "maximise the expected return on the fund subject to an acceptable risk, with risk measured in terms of international purchasing power".

3.2 However, even with this re-interpretation, we are left only with a reference to "acceptable" risk exposure. Furthermore, the reference to time horizon will be noted in connection with the discussion in the previous Section. Time horizon is only relevant if we choose to adopt a framework that admits time horizon dependent portfolio preferences. Although such frameworks do exist, their parameterisation is, as we have discussed previously, open to substantial subjectivity. Furthermore, again as discussed previously, simple and plausible frameworks exist that do not admit time horizon effects, regardless of parameter settings. In the absence of robust support for time horizon effects, we prefer to adopt a simpler and more practical approach.

Risk Minimisation

3.3 As discussed above, although the objectives of the fund suggest that an "acceptable" level of risk exposure can be allowed, there is no firm guidance

(other than the risk exposure implicit in the current Fund strategy) on what is an acceptable risk. A natural starting point is therefore to consider what a strategy that minimised risk would look like. Since this strategy minimises risk rather than eliminates it, it will still involve some risk in terms of international purchasing power. However, the "acceptable" level of risk can be no lower than this if the Fund is restricted to the conventional investible universe. (In theory counter parties such as banks will offer derivative contracts that replicate the purchasing power objective more closely, for example using contracts based on GDP, but not in the volumes required by the Fund).

- 3.4 A narrow interpretation of an objective that sought to minimise risk in terms of international purchasing power would define purchasing power in terms of the economies comprising the current trade weighted currency basket for Norway. The aim would then to be to preserve the value of consumption in these economies. This would suggest purchase of low risk real assets in each economy without any currency hedging.
- 3.5 The balance that needs to be struck between trade weighted currency exposure (biased towards economies close to Norway) and wider diversification in the global economy is discussed in the National Budget for 1998 (section 6.4 of the Budget report, titled "Investment of the Petroleum Fund"). The conclusion is that a compromise between import weights and GDP weights is appropriate. We will return to this issue in Section 5 but it suffices to note that even if the Fund adopts an objective of minimising risk in terms of purchasing power, there is still considerable uncertainty in terms of the basket of economies against which this risk should be measured.
- 3.6 In addition, there is a further complication. We have argued that the case for "time horizon" effects is weak in terms of preference for equities in portfolio selection models. However, we would argue that the case for different "least risk" strategies according to investor horizon is more robust. As described in "Strategic Asset Allocation" (Chapter 3) by Campbell and Viceira (2002), long dated inflation linked bonds are the least risk asset for a long term investor interested in preserving the consumption value of his wealth. This point is also made in the letter to the Ministry of Finance from Norges Bank dated 21 March 2001. Norges Bank tie together this duration issue and the choice of currency basket as follows (we replace the word "manager" with the word "investor"):

The concept of "risk minimising instrument" can mean different investments for various investors. What constitutes a risk-minimising investment depends both on when the investor's obligations arise in future and the denomination of the obligations. For an investor with a very short horizon, an investment in short treasury bills can be an investment with little or no risk. For an investor with a long horizon an inflation linked government bond with a long maturity will be the closest one comes to a risk free investment. In both cases it is assumed that the instrument is denominated in the currencies that correspond to the investor's obligations. For the Petroleum Fund, a broad currency basket is relevant for measuring return and risk because such a currency basket will minimise the currency risk for the Fund's future international purchasing power.

- 3.7 For those economies in our international currency basket where inflation linked bonds exist, the least risk strategy for the Fund would therefore involve purchase of such bonds with appropriate duration. However, this introduces further imprecision into a least risk strategy as the "duration" of the Fund is not well defined. One approach, based on the "handlingsregelen" would be to assume that the Government will spend 4% of the real value of the Fund each year. This suggests a duration of around 25 years. On the other hand this 4% assumption was equated with an assumed real return on the Fund. Based on current real yields on inflation linked government bonds, an annual real return of only around 2.5%pa is more realistic (a payout of 4%pa would not be sustainable indefinitely). A payout of 2.5% pa would suggest a duration of 40 years. In practice, whether the duration of the Funds investment horizon is 25 or 40 years, they are both well beyond the duration of the longest available (coupon) bonds in issue.
- 3.8 It should be noted that inflation linked bonds perfectly hedge inflation (subject to Sovereign Government risk) in the economy in which they are indexed and on the basis of the index calculation only. The failure of indices to capture issues such as quality improvements is well documented. Nevertheless, inflation linked bonds are the perfect hedge for an (price index measured) inflation linked liability in the economy of that index. (Regressing inflation linked bond returns against inflation does not reveal this since there is a time component to risk associated with the real interest rate, but a liability to pay an inflation linked amount N years forward is exactly matched by an N year zero coupon inflation linked bond.)
- 3.9 The construction of a dedicated "satellite" portfolio aimed at minimising risk is discussed in more detail in Section 6. This discusses empirical research suggesting that the least risk real asset in economies with no inflation linked bonds would be short dated conventional bonds. The role for equities (and property) would be small even on the basis of optimistic (low) volatility assumptions for these assets (see for example Dyson & Exley 1995 and Smith ⁷(1998) in the context of matching National Average Earnings growth).
- 3.10 In summary, however, our conclusion at this stage is that *if*:
 - the appropriate currency weights can be derived, and
 - the (real) liabilities have an implicit duration of around 25 years

then a risk minimising benchmark would consist of long dated inflation linked bond indices (in those economies issuing such bonds) and conventional bonds with a maturity of around 10 years (in other economies). Although this minimises risk, even if the currency weights could be specified optimally, this still involves

⁷ See http://www.gemstudy.com/defined_benefit_pensions.htm

material risk relative to a notional 25 year duration inflation linked liability (see below). Furthermore, based on current global real yields on inflation linked bonds the expected real return from such a bond orientated strategy would currently be in the region of only around 3%pa.

"Acceptable" Risk

3.11 The above discussion suggested that the role for equities in a risk minimising strategy would be minor, in the region of 10% at most. However, the objectives of the fund appear to extend beyond minimising the risk to purchasing power. We have noted in particular that the objective is interpreted more widely in the letter from Norges Bank to the Ministry (21 March 2002). This letter states that:

an ideal strategy would be to own a portion of the instruments where the return directly or indirectly comes from future international production of goods and services.

This interpretation introduces the concept of returns to capital (since the Fund can only invest in financial assets) employed in the international production of goods and services. The current 40% equity allocation is well in excess of the level (around 10% equity or less) that would be consistent with minimising risk to purchasing power and is far more consistent with an objective that encompasses exposure to such risk capital. However, there does not appear to be any precise link between this wider objective and the 40% equity exposure in the publicly available Fund documentation.

- 3.12 Thus, in summary, the current policy reveals an implicit risk tolerance that equates with the equity exposure of around 40%, but this is working backwards from the current policy and not derived from the stated objectives. We see the stated objectives instead as reflecting merely the willingness of Government to tolerate some annual fluctuations in fund value and revealing a tolerance for risk beyond the simple risk minimisation policy described above, but does not define "acceptable risk" with any precision.
- 3.13 In order to estimate the risk associated with various investment strategies relative to long dated real liabilities, there are two basic approaches that could be followed. Firstly, we could build a model of the long term behaviour of various asset classes and a model of the long term (25 year) behaviour of inflation and we could analyse the risks of the former relative to the latter. However, there are pitfalls in this approach:
 - We question the confidence that can be placed in any model of global inflation or financial asset returns over such long periods there is simply not enough data to establish robust statistical relationships.
 - Even if a model could be built, there is no obvious measure of risk over such long periods that can usefully be applied in the real world. For example if we

look at the probabilities of events happening over 25 year periods, it is not clear what probability level is acceptable (for an event that will in practical terms happen only once) nor is it clear how the risk will manifest itself in real time (given that the decision makers will need to account for and justify their decisions over a much shorter time horizon).

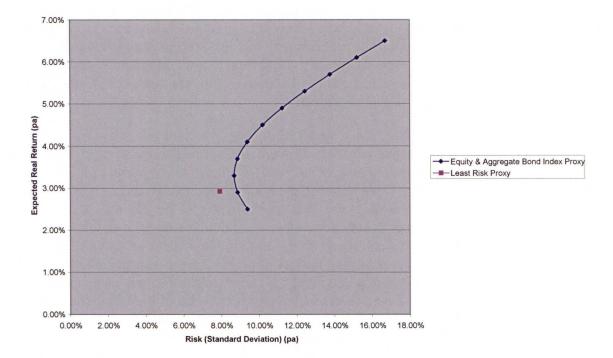
- 3.14 The second approach, which we would regard as the more modern stance, uses real time market data to derive risk measures, but involves approximations in this application. Conceptually, we would assume that a global inflation linked bond existed and we could observe the price movements of this bond relative to other financial assets. In this case it is clear that the Fund could exactly meet an objective of maintaining international purchasing power by investing in this bond (albeit perhaps expecting to earn only a low real return, given its riskless nature). Thus, the strategic risk taken by any investment policy could meaningfully be measured as the quarterly or annual (say) risk relative to the global inflation linked bond. The problem with this approach is of course that a global inflation linked bond does not exist and even though inflation linked bonds do now exist in the US, the largest world economy, the data history is too short to derive useful quarterly or annual statistics.
- Nevertheless, given the pitfalls of the first approach, we prefer to adopt a proxy 3.15 for the second conceptual approach described above in order to illustrate the risks associated with investment policies relative to long term inflation linked liabilities. Unfortunately, though, we need to use the UK economy as our proxy for these calculations. Throughout the world the UK is the only economy with a long (nearly twenty years since inception) history of inflation linked bond data from a large and reasonably well developed market (certainly over the last fifteen years). By measuring the risk of global equities (hedged into sterling) and sterling denominated bonds against UK inflation linked bonds using quarterly data over this period we thus derive a proxy for the risk of global equities and bonds relative to our notional global inflation linked bonds. (We also use the risk between short and long dated UK inflation linked bonds as a measure of the "duration" risk between short and long dated global inflation linked bonds). This assumes of course that the UK financial markets are representative of global experience and the results can thus be regarded as indicative only.
- 3.16 Using 15 years of quarterly UK data we can thus estimate annual risk of various investment policies, relative to a real liability with 25 year duration, and compare it with the characteristics of a "least risk" strategy. The "least risk" strategy is assumed to be 45% invested in aggregate inflation linked bond indices (duration 10 years) and 45% invested in appropriate duration (8 year duration) conventional bonds to reflect economies without inflation linked bond issues, with the remaining 10% invested in equities. The bond component of the equity/bond strategy is assumed to be fixed income only, with a duration of 5 years (as a proxy for the Lehman Aggregate index). We used currency hedged returns on the FTSE

world index as our proxy for equities and assume an equity risk premium of 4%pa.

Relative Risk	Expected	Real	Return
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Least Risk Strategy (aggregate)	8.0%pa	2.9%pa
40% World Equities, 60% Bonds	9.4%pa	4.1%pa

The risk and return characteristics, relative to the implicit liabilities, is shown below for a full range of strategies from 0% to 100% equities.



3.17 The current strategy represents one possible view of acceptable risk. As the diagram shows, the risk of this strategy is not substantially in excess of the risk associated with a "least risk" strategy (which for practical reasons is still quite a long way from an ideal match). The "flat nosed" shape of the efficient frontier in the vicinity of the current strategy suggests that the expected return rises quite significantly for relatively small increases in risk. However, the choice of the current risk versus return trade-off is ultimately subjective.

Transparency

- 3.18 Thus far we have established that even if the liabilities could be well defined (and in practice the choice of optimal currency weights is unclear, as is the precise duration of the liability), the Fund's objective does not appear to be minimisation of risk. To a certain extent our interpretation here is derived from what the objective *doesn't* say, since an objective of risk minimisation could have been expressed simply by Government in a few words. Nevertheless we have identified a risk minimising strategy, albeit with a large residual risk. The current strategy does not appear to increase this risk substantially, but the choice of risk level is subjective.
- 3.19 We have also noted that the Government's objectives refer to an acceptable level of risk, but this acceptability can only, we assume, be derived "backwards" from the current policy, which implies a certain risk tolerance.
- 3.20 In the context of this difficulty of deriving a strategy from the objectives set for the fund, we also note that another objective of the Fund appears to be transparency. This is referred to in many references to the Petroleum Fund. Although we have assumed that this is not a critical objective in determining strategy, the fact that the strategy currently adopted is difficult to rationalise precisely in terms of the stated objectives could be said to involve a lack of transparency in the decision making process.

Conclusions

- 3.21 Given this lack of precision in the objectives, we will consider in the next section the possibility of adopting a new, transparent, approach to setting strategy arriving at an equity exposure in "core" strategy that is currently close to, but slightly above, that of the current strategy.
- 3.22 In view of the uncertainty in the "acceptable" level of risk in the Fund, and the shape of the "efficient frontier" described above, it would seem possible that the slight increase in equity exposure in the core strategy may be tolerated, but we do not pre judge this issue. However, having established the "least risk" strategy (albeit with a high degree of residual risk), the overall equity exposure can be controlled, if required, by combining our "core" strategy discussed in the following sections with a "satellite" strategy with a risk minimisation objective.
- 3.23 We return to this core/satellite construction in the final Section 6. In the meantime we will concentrate on the core strategy, with an implied risk exposure slightly in excess of that *implied* by the current strategy (albeit not necessarily outside the risk tolerance that could be inferred from the stated objective).

4

The Market Capitalisation Weighted Benchmark

Introduction

- 4.1 The natural "model" portfolio of global financial assets is a market capitalisation weighted benchmark.
- 4.2 The market portfolio has special status under the assumptions of the Capital Asset Pricing Model (CAPM), but the appeal of this portfolio is not dependent on CAPM alone. Arguably, the CAPM equilibrium model seeks to ensure that investors hold this market portfolio precisely because it is a prerequisite of any equilibrium model to explain why in aggregate investors hold this market portfolio the CAPM model just happens to be the simplest equilibrium model achieving this.
- 4.3 We will reiterate several times that the main "theoretical" justification for global market capitalised weights is based on the simple "adding up" rule that ensures that the "average" global investor must hold this portfolio.
- 4.4 We will consider the relevance (or otherwise) of some of the other theoretical arguments for a market capitalised benchmark below. However we focus firstly (and primarily) on the practical and investment issues.

Practical Issues

- 4.5 Market capitalisation weighted benchmarks have a number of distinct practical advantages.
- 4.6 On the other hand, the letter from Norges Bank to the Ministry of Finance dated 21 March 2001 covers a number of practical criticisms of market weights:
 - ix. The portfolio that is managed is not sufficiently large for all available alternatives to be represented in a meaningful way.
 - x. The marginal diversification gains decline as more assets are included in the portfolio.

xi. A number of instruments are so highly correlated that the gains that can be achieved from including all the instruments are marginal compared with investing in a smaller selection.

We have little to add to these criticisms and they will form the basis of our analysis in later sections. We address these issues by starting with the Global Market Capitalised Portfolio as representative of the portfolio of financial assets held by the average global investor (see above). We then use the machinery of the CAPM model to fine tune our analysis. In other words we will actually use CAPM as an effective tool to analyse these issues rather than using these issues to reject CAPM.

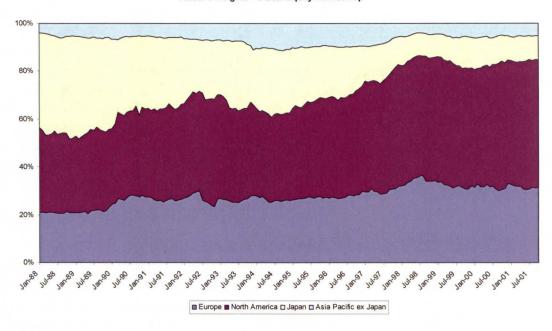
4.7 Some other practical drawbacks relate to the details of construction of a market capitalisation index.

However, we do not consider these to be serious drawbacks when compared with the practical advantages and underpinning theoretical and "transparency" advantages of market capitalisation weights as a model exposure to global financial assets. Although adjustments could be made to the recognised market capitalised indices, the practical benefit of these adjustments would need to be weighed against the added complexity, and possible subjectivity, involved.

Investment Issues

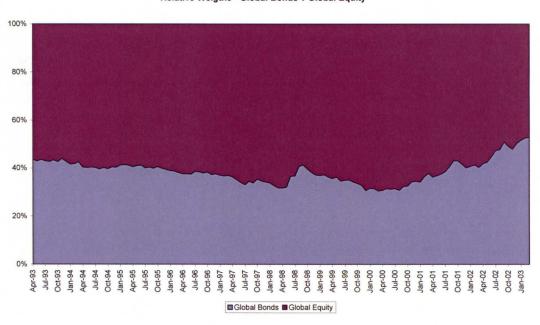
4.8 The relative weights between different geographic regions and asset classes have varied significantly over recent history. This can be observed in the graphs below which shows the relative movements in the different components of Global Equity Market Cap, and in the latter graph between Global Equity and Global Bonds.

Relative weights - Global Equity Market Cap



Source: MSCI

Relative Weigths - Global Bonds v Global Equity



Source: MSCI and Lehman Brothers

4.9 Investment practitioners would level a number of criticisms at a global market capitalised benchmark from an investment perspective.

- i. Given the fluctuations shown above, it is easy with hindsight to give examples where a market weighted benchmark would have bought a market "at the top" and underperformed some arbitrary fixed weights. Often such fixed weights are rationalised in terms of GDP weights, although it is unclear why GDP weights are appropriate for financial assets. Other times fixed weights are described as "natural diversification" such as investing one third in each main economic bloc although the choice of the definitions of economic blocs and the arguments for equal weights seem even less justifiable than GDP weights. However, when these non-market weights are chosen without the benefit of hindsight, it is less easy to demonstrate that they necessarily out perform.
- ii. There is a widespread belief among investment practitioners that markets mean revert. Some of the reasons why mean reversion tends to be observed "in sample" but not "out of sample" were discussed, with references, in Section 1 (the phenomenon of "small sample bias"). If markets do mean revert then fixed weights will out perform. However, it should be noted that it is possible for capitalised values of markets to mean revert without investors seeing mean reverting returns for example by the issuance of new capital.
- iii. The mathematical artefacts of a rebalancing policy may be confused with the actual value of the policy. For example, if we invest NKr 100 in one fund adopting a fixed weight asset allocation and NKr 100 in another fund with no rebalancing (akin to market weights), they both obviously have a value now of NKr 100. In other words knowledge of future rebalancing policy does not (ignoring transaction costs) add to the value of a portfolio today.
- iv. Many practitioners accept the principles of market weights selectively.
- v. As we discuss below, the intuitive appeal of market weights as capturing global production is less strong in the case of Government debt. However, the general principle of holding a portfolio of global financial assets that is representative of a global average investor remains in force.
- 4.10 From an investment viewpoint, it should be noted that the risk of a market capitalised portfolio may vary over time due to the equity versus bond weights changing. This change in weights over time is not inevitable, for example even if equities return 50% more than bonds, it is possible that Governments will issue 50% more bonds, thus keeping market weights constant. However, market

movements could easily return the equity weight back to nearer 70% (the level at the beginning of 2000).

4.11 In the next section we will compare this portfolio with the current strategy in terms of various risk factor exposures.

Theory - Relationship with CAPM

4.12 Seen in isolation, the CAPM based argument for market capitalisation weights is naturally open to a number of criticisms. These are also described in the letter from Norges Bank to the Ministry of Finance dated 21 March 2001.

Our aim here is *not* to offer an uncompromising defence of CAPM, the limitations of the theory are well known. CAPM is remarkable because as a simple model it can give insight, but as a simple model it is clearly open to many criticisms. In our view the model is more defensible as a simple tool for the "perturbation" analysis that we propose.

4.13 However, in response to these criticisms we would note that the main alleged weakness of CAPM under the first criticism is probably "home bias", which is a consequence of imperfect capital mobility. This is discussed in V.Errunza, K.Hogan and M-W, Hung⁸. The abstract of this paper reads as follows:

We examine whether portfolios of domestically traded securities can mimic foreign indices so that investment in assets that trade only abroad is not necessary to exhaust the gains from international diversification. We use monthly data from 1976 to 1993 for seven developed and nine emerging markets. Return correlations, mean-variance spanning, and Sharpe ratio tests provide strong evidence that gains beyond those attainable through home-made diversification have become statistically and economically insignificant. Finally, we show that the incremental gains from international diversification beyond home-made diversification portfolios have diminished over time in a way consistent with changes in investment barriers.

We cite these results to suggest that apparent home bias in investor portfolios is not in itself an argument against the CAPM framework.

4.14 In response to the second criticism, the assumption that investors are concerned only with the first two moments of return is a restrictive assumption, but it is shared by many other applications (if not all applications) of "mean-variance" analysis. Whilst one can finesse the characterisation of risk to higher moments,

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⁸ "Can the Gains from International Diversification Be Achieved without Trading Abroad?" (Journal of Finance, Vol LIV, No.6 December 1999 pp 2075-2107)

- or "downside" measures, it becomes difficult to determine which risk measure concerns any particular group of investors.
- 4.15 In fact, in dealing with all of these three criticisms, the fundamental issue to which we return is that even without the CAPM assumptions, arithmetic (adding up the portfolio of every investor in the world) determines that the market portfolio must be the "average investor's" portfolio of financial assets. If we start instead with this as our justification for market weights, then we will need a model (such as CAPM) only to determine how the characteristics of an individual investor determine *perturbations* from this position. It is our view that, given all of the other uncertainties in Fund objectives, and the appeal of a simple and transparent approach, such adjustments are not necessary.

Theory - "Ricardian" Analysis

- 4.16 Although we have not assumed this to be an overriding objective, the choice of the average investors' portfolio under the market capitalisation approach does also have some appeal even from a Ricardian standpoint (taking as given that the assets are not simply given back to individuals).
- 4.17 Although the Petroleum assets represent only around 6-7% of total National Wealth, given that the remaining wealth is dominated by human capital (around 80%) it would appear that this fund could form a high proportion of Norwegians' total financial assets. If we assume that the average Norwegian individual would rationally adopt this market capitalised asset allocation (or a home made proxy) out of choice, then it is arguable that the market allocation of the Fund minimises transaction costs borne by individuals in achieving their desired personal portfolio.
- 4.18 Seen from this Norwegian individual's perspective one of the more pertinent arguments against market capitalisation weights as representative of his preferred asset allocation is that different investors around the world may have different "hidden" non financial assets. Ideally all of these assets should be included in any analysis but in practical terms such adjustments would be problematic and would again destroy the simplicity of the approach.

Theory - Global Production

4.19 From a macro economic standpoint, the existence of substantial non financial assets also undermines more ambitious claims for the market capitalisation portfolio as representative of global production. Whilst this characterisation of a market capitalised portfolio has strong appeal in satisfying the objectives of the Fund discussed in the previous section, it must be acknowledged that the market capitalised portfolio unfortunately captures only part of this global aggregate.

However, the main missing component in the replication of global production is of course the value of human capital. If it could be argued that Norwegian citizens' own human capital is a proxy for this then combining the market capitalisation portfolio with this personal human capital may not be far away from a representation of total production. This is simply a restatement of the problem of hidden non-financial assets, with human capital being the largest item.

4.20 Once again, although these macro economic aspects can be discussed further, we see no strong argument against the use of a market capitalised benchmark from this standpoint.

Summary

- 4.21 We have stressed the practical aspect of market weights. We will use theories such as CAPM only at a secondary level to analyse the impact of including or excluding certain assets from the market portfolio. This is in our view a robust way of using such models.
- 4.22 If modelling is used in this way (ie starting with the market weights and using CAPM to back out the benefits of diversification) then from the perspective of the management of the fund, this "modelling" approach also offers a straightforward asset allocation process. If a new asset class is to be considered then we need only ask:
 - a. What is its weight in the market portfolio?; and
 - b. Is the improvement to the risk and return profile worthwhile?
- 4.23 In terms of more conventional model based "risk analysis", we will mainly restrict this to an analysis in the next section of the main risk factor exposures in the market portfolio. We consider this approach to be consistent with the fact that even if risk could be modelled accurately over long periods the objectives do not in any event give precise guidance as to what is "acceptable" to within the tolerances required to make such detailed analysis worthwhile.

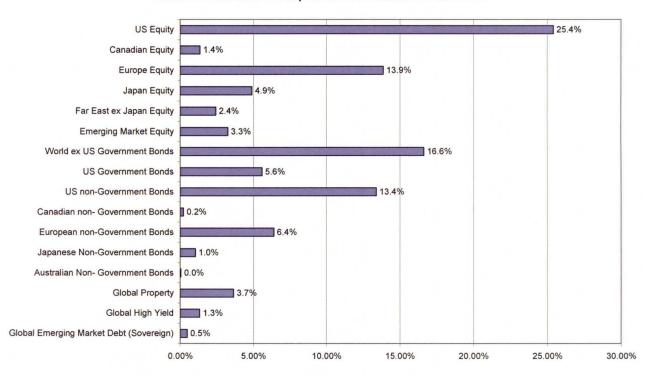
5

Analysis of Risk Exposures of Global Market Capitalisation Portfolio

Composition

5.1 In broad terms a global market capitalisation portfolio looked as shown in the graph below as at 30 June 2002, based on Salomon Smith Barney data for equities, Lehman Brothers and Merrill Lynch data for bonds and using data for total investible market in Real Estate supplied by Hendersons, but adjusted to allow approximately for the component of the property market held by listed companies (which is already implicitly included in the equity market valuations):

Estimated Global Market Capitalisation Distribution 30 June 2003



- 5.2 The equity weights use SSB estimates of total market capitalisation (i.e. beyond those covered by the standard SSB indices, which incorporate free float adjustments). We believe this to be consistent with the principles of the market capitalisation approach. We have not made any adjustments for cross holdings by institutions such as pension funds, although it is estimated that the US equity market for example is over stated by about 10% due to this effect.
- 5.3 The 4% weight for real estate holdings is also approximate and represents an adjustment to allow for property holdings of listed companies. It is appropriate to make allowance for this form of cross holding as it is significant an estimated two thirds of institutionally investible global property assets are held by listed companies. We have used a figure for total property assets from Henderson Global Investors, Revisiting the Case for Global Property Investment, November 2002 and reduced it by two thirds.
- 5.4 Whilst we are open to further discussions on the details of the construction of the above benchmark weights, our overall view is that there is in practice some conflict between the theoretical principles behind the market capitalisation approach and the principle of transparency. Whilst theoretically all of the allocations can be questioned, we believe that from a transparency perspective, a generally accepted publicly available statistic is more credible than one subject to overly detailed adjustments.

Primary Asset Exposure

- 5.5 The striking feature of the above market portfolio is in how close this portfolio is (within the tolerances of an alternative model based solution and within the uncertainty of the "acceptable" risk tolerance implied by the Fund objective) to the current strategy. (This is of course partly a function of the recent falls in equity values).
- 5.6 The important risk exposure to note is that the above portfolio has an equity allocation of 52% (as at end November 2002). This is 12% higher than the current equity exposure. The increase in equity allocation would be largely accounted for by benchmark allocations to the smaller capitalisation equities excluded from the current standard benchmark FTSE All World benchmark indices (we understand that existing smaller company portfolios are effectively "off benchmark").
- 5.7 It is generally accepted that the characteristics of Real Estate fall mid way between equities and fixed income. On this basis, combining one half of the Real Estate allocation with the equity allocation, plus one half of the emerging market debt and high yield bond allocations (also with equity characteristics) suggests that overall the market capitalised portfolio has around 15% more equity exposure (as at end November 2002) when compared with the current 40% equity benchmark of the Fund.

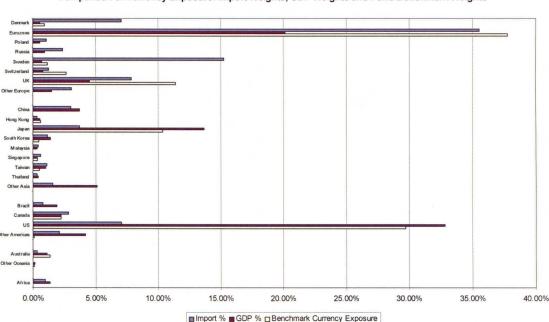
- 5.8 We have already shown in Section 2 the approximate risk of various equity and bond allocations. This is intended to be indicative only.
 - It will be seen that risk does vary depending on the implicit liabilities against which risk is measured. The impact of implicit liabilities in affecting risk is one justification for "time horizon" effects, although it will be seen that the impact varies depending on the risk level.
- 5.9 The shortcomings of using the UK data as a proxy for this analysis can be seen by comparing the absolute risk for the 52% equity strategy (roughly 9.7%pa) with the risk calculated for the Global Market Portfolio (around 8.3%, as discussed below). This illustrates the benefits of international diversification that cannot be captured in a single country model.

Approximate Risk Profile

- 5.10 As discussed above, the absence of data on a global inflation linked bond market makes it impossible to analyse risk reliably relative to an (implicit) long duration inflation linked liability. However, the analysis above also suggests that for equity allocations in the region of 50% (using UK data) the difference in risk measured in absolute terms and measured relative to such a liability may not be substantial (in the context of the precision in the risk tolerance).
- 5.11 The covariance matrix used for our risk calculations is set out in Appendix A. This uses monthly data covering the longest available time periods for each asset class.
- 5.12 We have therefore calculated the risk of the market capitalised portfolio in absolute terms, for which a long data series is available. We calculate the risk as 8.25%pa. More importantly we have used bootstrapping methods with actual monthly data to simulate the distribution of returns from this portfolio.

Currency Exposures

5.13 The table below compares the implicit currency exposure of the market capitalisation weighted strategy with the current exposures and with import weights and global GDP weights.



Comparison of Currency Exposure: Import Weights, GDP Weights and Fund Benchmark Weights

The implicit currency exposures achieved with the use of market capitalisation benchmark weights could be modified by the use of currency hedging (or, if the Fund establishes a minimum risk "satellite" asset pool as described in Section 2, by altering the currency weights in this pool).

- 5.14 The proposed benchmark clearly has a greater exposure to US Dollars and lower exposure to the Euro when compared with the current strategy. The current exposure to currency is a compromise between import weights and global GDP weights. However, it is unclear why global GDP weights are preferred over market capitalisation weights. GDP is a backward looking accounting aggregate only and the weights are not representative of the *present value* of total global GDP. Weighting the currency exposures of financial asset values (which *do* represent present values) with these historic accounting aggregates therefore mixes two different quantities.
- 5.15 If we regarded market capitalisation weights as representative of the value of future production (the inherent approximations were discussed in section 2) then it would be implicit that the currency exposures of these market weights would not require any adjustment. The fact that market capitalisation weights of financial

- assets represent only a proxy for this production does however leave room for the correct weights to be closer to GDP weights.
- 5.16 However, the use of unadjusted market capitalisation weights has the benefit of simplicity and avoids spurious adjustments such as treating all earnings of US listed companies as US Dollar denominated in reality some of the earnings will be in Euros. Furthermore, if currency hedges were put in place then the Fund would see ownership of a fluctuating proportion of global financial assets that would be difficult to justify. By adopting the currency weights implied by the market weights, the Fund would (in principle) own a constant proportion of these assets over time.

Interest Rate Risk

- 5.17 The Fund currently uses Lehman Aggregate Indices for its bond exposure and, as such, the duration should not be markedly different from the global market cap portfolio, although the underweighting of Japan by the Fund may have a small impact. The duration of the Lehman aggregate world index is currently just under 5 years.
- 5.18 A small difference in the duration of the bond portfolio is not a major contributor to the overall risk profile of the fund. In broad terms interest rate volatility is likely to be in the region of 0.5% to 1%pa, but it is imperfectly correlated with equity risk, which is the main risk factor.
- 5.19 As discussed in Section 2, the Fund has an implicit liability that could be matched with inflation- linked bonds. It could thus be argued that the bond portfolio should be modified to reflect the fact that the Fund measures risk relative to this liability, rather than relative to cash. Based on the approximate result that the duration of the conventional bond portfolio should be around one third of the duration of the real liability this would in fact probably suggest adopting a slightly longer duration bond benchmark. However, such adjustments would in our view contribute little in practical terms whilst complicating the simplicity of the market capitalisation approach.

Sector Exposures

- 5.20 Both the current strategy and the proposed strategy adopt unadjusted sector exposures, although whilst the oil reserves exist a case could be made for adjusting the equity benchmark by exclusion of, say, equities in the Oil & Gas sector of the index. These currently account for around 7% of global market capitalisation (source: Salomon Brothers).
- 5.21 Of course, in principle bonds issued by companies in this sector should also then be excluded.

- 5.22 The exclusion of this sector would, however, allow the Fund to adopt a global market benchmark with less adjustment to the existing equity versus bond split.
- 5.23 In principle this analysis could be extended to other assets with an *empirical* (observed historical) correlation with oil wealth so as to produce a statistical *tilt* of the whole portfolio away from oil wealth. However, such tilts are in danger of focussing on relationships occurring by chance in the data. By contrast, the Oil and Gas sector of the equity market has a plausible theoretical justification for a link with oil prices which is merely confirmed by statistical analysis. In general, use of statistical analysis to confirm a theoretical prior is a far more reliable approach than reliance on statistical relationships alone.
- 5.24 Having said all of this, the exclusion of an entire sector from the Fund's equity exposure would be a major decision and has knock on implications in a number of other areas, such as the overall diversification of the equity portfolio. We would therefore recommend that further research is carried out before a final decision is made on this issue.

6

Diversification Gains within Market Portfolio

6.1 In this section we use some of the theory behind the market capitalisation weighted portfolio under CAPM to derive risk and return characteristics of the current portfolio, we then use these to *rank* the actual diversification gains from including various asset classes in the market portfolio benchmark.

The Approach

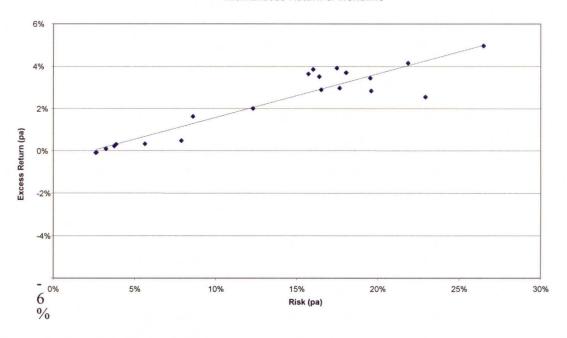
- 6.2 In the previous section we introduced the market capitalisation weighted portfolio as our model asset allocation for a typical investor. We can use the assumptions underlying the Capital Asset Pricing Model to derive from this portfolio the expected excess returns (over the risk free return in the base currency) on the constituent assets.
- 6.3 Given that currency risk can in theory be hedged at no cost by any global investor, we work with currency hedged returns on all assets. This provides results broadly consistent with the approach previously used by the Fund, whereby local currency returns are considered for each asset. This analysis produces the following risk premia relative to cash (shown on a scale from 1 to 15 with 1 being the highest expected return and 15 being the lowest):

Asset Class	Expected Return (% pa)
US Equity	3
Canadian Equity	4
Europe Equity	5
Japan Equity	7
Far East ex Japan Equity	2
Emerging Market Equity	1
World ex US Government Bonds	12
US Government Bonds	12
US non-Government Bonds	11
Canadian non- Government Bonds	13
European non-Government Bonds	15
Japanese Non-Government Bonds	15
Australian Non- Government Bonds	14

Asset Class	Expected Return (% pa)			
Global Property	9			
Global High Yield	10			
Global Emerging Market Debt (Sovereign)	6			
Total	8			

- 6.4 It will be seen that the returns for non-government debt are anomalously low, but otherwise the relative ranking of expected returns is not unreasonable. A common assumption in asset allocation models that lack such calibration is that the expected returns on all equity assets are the same. Our approach reveals that the expected excess returns are close, but not identical, and by construction, use of these slightly different expected excess returns reproduces market portfolio weights in the optimal asset allocation.
- 6.5 The anomalous results for non-Government debt are a consequence of a well known effect whereby non-Government debt appears to have a lower volatility of return than Government debt (in our calibration this is partly a function of the data periods available for the respective assets). Of course if it is believed that the returns on non-government debt are actually anomalously high then this adjustment can be criticised. However, on the more plausible assumption that the returns on corporate bonds are non-normal, this adjustment would appear to be more desirable than using prospective (or historic) estimates of expected return to argue for excess allocations to non-Government debt without allowing for non normality of returns. Some of the issues associated with modelling corporate debt are discussed in Exley & Smith (2002).
- Another reasonableness check for these results is the simple regression of risk against the calculated excess return, as shown below.

Risk/Excess Return & Trendline



6.7 Ranking the Contribution to Diversification

We can now use this model to rank the diversification benefit gained by including various asset classes. This aims to address one of the criticisms of the approach discussed in Section 3, namely that the diversification benefits of some asset classes are vanishingly small. More importantly, it gives us a theoretical framework for deciding on whether to include one asset class and reject another.

- 6.8 Ideally all excluded assets will fall below a certain score (expressed as a loss of expected return on the asset) and all included assets will fall above this score. However, this is an over simplification for a number of reasons:
 - i. Although we assume, implicitly, that all returns are net of average asset management fees, some assets will have additional implicit expenses for the fund that may rule out inclusion such as additional monitoring expenses or lack of transparency. We concede that it is difficult to directly compare these qualitative "costs" with the quantitative basis of our ranking.
 - ii. It may be found that US corporate bonds are worth including, but Canadian corporate bonds are not, in isolation. However, when combined as "North American" corporate bonds both may merit inclusion. This shows that the ranking is just a tool and needs some basic rationale for the sub classification between US and Canadian bonds for example. We

- would suggest that an asset should be considered separately if it requires separate management, reporting etc.
- 6.9 It should also be noted that the analysis refers to the ranking of removing single assets. Clearly as more assets are removed the marginal benefit of the second, third, fourth assets in diversification terms will generally be found to be higher.

Sensitivity Testing to Historical Data Period

6.10 Our ranking of the various asset classes in terms of diversification benefit depends on the assumed volatility and correlation of the various asset classes, which we have derived from the longest available periods of data. In order to test the sensitivity of the results to these assumptions we have re-run the analysis using only the most recent five years of data. It should be noted that the analysis is of no relevance in the case of Global High Yield and European, Japanese and Canadian non Government bonds as this data is in any event limited to only five years of history. However, the dominant term in the calculation of the ranking of these assets is likely to be the low market capitalisation weight. Overall, the results show a similar pattern also over this period – particularly in relation to emerging market equity, small cap equity and real estate (the specific rankings change but the general positioning does not).

Application to Non-Market Capitalised Portfolios

6.11 Although the strict mathematical justification for this analysis breaks down for non market weighted benchmarks, if a portfolio is broadly similar to a market characteristics) then the above rankings are still likely to provide a reasonable indication of diversification benefit for the smaller asset classes. This is because the main driver for the diversification benefit is the correlation (or lack of correlation) with the major asset classes, which should be broadly similar in both cases.

Qualitative Considerations in the Inclusion of Asset Classes

- 6.12 Separate analysis provided to the Ministry cover in detail the practical and investment considerations of a number of the asset classes included in the preceding analysis: global small cap equity, real estate and emerging market debt. The broad conclusions of those reviews are set out below. Comments on private equity and inflation-linked bonds follow.
 - We have already said that we see a clear case for the extension of the equity benchmarks to include **Small Cap Equity** (with the possible exception of Far East ex Japan equity) and our qualitative assessment of this asset class does nothing to undermine this conclusion. It is important to emphasise that this view does not depend upon the existence or otherwise of what is called the "Small Cap Effect" (that small cap can be

expected to outperform larger capitalization stocks and that this excess return is not readily accounted for by excess risk). The analysis given in this Section implicitly assumes that excess risk-adjusted returns are not available from any asset class.

- We have argued for the quantitative case of including **Real Estate** but the qualitative case is more equivocal. The easiest means of gaining exposure, via Real Estate Investment Trusts, is unlikely to offer a diversified global exposure (it will be principally US and UK), may be tax inefficient and the Fund is likely to need to acquire a significant share of the market to gain a 5% exposure with a market cap portfolio. Direct holdings of real estate could solve all these problems, but may introduce other more significant ones.
- The principal argument against **Emerging Market Debt** is the one resulting from our analysis above: that it contributes little to the portfolio, given its low market cap weight. Aside from that, it poses few particular problems, provided the issuers are acceptable and the Fund is prepared to permit exposure to lower credit quality issues.

Private Equity

6.13 Although no reliable data is available that would permit us to include private equity in our numerical analysis, the results for the above assets suggest that it is also unlikely that private equity will make a significant contribution to the risk profile. The potential difficulties in gaining initial exposure and subsequently managing it, in particular in terms of the general aim of operating the Fund on a transparent basis, would tend to argue against its inclusion in practice.

Inflation Linked Bonds

- 6.14 Taken at face value as a risky asset within a global market capitalisation weighted portfolio, inflation linked bonds are an unexceptional and small asset class (around 0.75% of total global financial assets).
- 6.15 The lower volatility of real interest rates relative to nominal rates tends to give inflation linked bonds a lower absolute volatility than nominal bonds and suggests a lower return premium.
- 6.16 Although excluded from the above quantitative analysis due to shortage of data, it is clear that since the market capitalised allocation is negligibly small and the risk characteristics muted, inclusion of the asset at this weight will have no material impact on risk characteristics of the market portfolio.
- 6.17 The more significant potential role for this asset is as a component of a possible least risk "satellite", which we discuss in the final section of this report.

7

Consideration of a Least Risk Satellite Portfolio

The Satellite Portfolio Concept

- 7.1 The previous sections have been concerned with the asset allocation of the "core" portfolio of global financial assets, for which we recommend a market capitalisation weighted portfolio, subject to tests of materiality for minor asset classes.
- 7.2 However, we commented in section 2 that although the objectives of the Fund did not give firm guidance on the "acceptable" level of risk, the current strategy, with 40% equities implied a certain risk tolerance. In section 4 we suggested that the market capitalised portfolio has an effective equity exposure (as at end November 2002) of around 15% more than the current strategy (after due allowance for the equity characteristics of Real Estate, Emerging Market Debt and High Yield).
- 7.3 Thus in simple terms, to restore equity exposure down to 40%, a "least risk" bond satellite portfolio of around 25% of the total fund would need to be constructed. (We suggest for practical purposes ignoring the minor equity allocation in the theoretical least risk portfolio allocation for this purpose). The remaining 75% of the portfolio would be allocated to a global market capitalisation weighted benchmark.
- 7.4 This assumes that the existing 40% equity allocation is maintained. The possibility of holding only the core benchmark portfolio could of course be considered. Indeed the results in previous sections suggest relatively modest reductions in risk associated with reducing the equity allocation at these levels of exposure.

- 7.5 If we follow the principles of the rest of this report then the natural starting point would thus be the market capitalisation weighted portfolio of long dated index linked Government bonds from all of the issuing countries. However, once we overweight this asset class beyond its global market weights (potentially by a factor of 30x) the concentration of this portfolio in particular economies and in particular currencies does become a concern.
- 7.6 The currency concentration of these bonds should be addressed by modifying the currency exposure back to consumption based weights using currency hedging.
- 7.7 The concentration in particular economies (and in relatively small markets within economies) and exposures within economies that do not issue this form of debt should be addressed by using a proxy for inflation linked bonds.

Inflation Linked Proxies.

- 7.8 As discussed in Section 2, analysis of the extensive UK data on inflation linked bonds shows that conventional bonds actually provide the next best proxy for matching an inflation linked liability.
- 7.9 For example based on the past five years of data for the UK the optimal portfolio to hedge long term inflation linked liabilities (in the absence of inflation linked bonds) would allocate only around 3% to equities with the remainder in nominal bonds. For an economy with inflation (expectation) volatility similar to that in the UK, the duration of the bond portfolio would be around one third of the duration of the real liability being hedged.

Combined Strategy

- 7.10 Thus, we are recommending that any least risk "satellite" strategy should consist of an aggregate benchmark of inflation linked bonds in those economies issuing these bonds combined with a portfolio of 10 year maturity bonds in those economies that do not issue inflation linked. There is less justification for "market weights" of economies in these portfolios. We would recommend that economy weights for this satellite portfolio are based on import weights.
- 7.11 In view of the size and liquidity of the global inflation-linked market, we would recommend that in practice a maximum of only 3% of any inflation linked market be held by the Fund in inflation-linked bonds. Where this limit is exceeded, the conventional bond proxy should be adopted even in economies issuing inflation linked bonds.

Conclusions

7.12 There is uncertainty in the definition of the Fund's liabilities. The least risk strategy depends crucially on the choice of currency weights and the choice of

(implicit) duration of the liabilities. Even where these two parameters can be identified, it seems likely that second of these will be well beyond the duration of deep markets in inflation linked bonds for a Fund this size. For economies without inflation linked bonds, there is a substantial residual risk associated with attempting to hedge long dated inflation linked (implicit) liabilities with conventional bonds.

7.13 Our overall conclusion is that the satellite portfolio is likely to be only a weak proxy for the implicit liabilities. Nevertheless, it provides a rational mechanism for reducing risk in the core portfolio if required.

Appendix A

Table of Covariance Matrix

US Large	US Large Cap Equity	Canadian Large Cap Equity	Europe Large Cap Equity	Japan Large Cap Equity	Far East ex Japan Large Cap Equity	Emerging Market Equity	World ex US Government Bonds	US Government Bonds	US Small Cap Equity	Canada Small Cap Equity	
Cap Equity	0.025661247	0.021745256	0.017884654	0.010165091	0.0211892	0.022540671	0.001282133	0.000639146	0.021995743	0.014487984	
Canadian Large Cap Equity	0.021745256	0.032577246	0.018181073	0.010661693	0.025179436	0.022932769	0.001129025	0.000637483	0.021525515	0.020925823	
Europe Large Cap Equity	0.017884654	0.018181073	0.024719848	0.012876151	0.022426928	0.02676246	0.001331129	-6.13407E-05	0.01992048	0.015084307	
Japan Large Cap Equity	0.010165091	0.010661693	0.012876151	0.038383291	0.012455593	0.020998896	0.00139965	0.001129919	0.014615193	0.013269484	
Far East ex Japan Large Cap Equity	0.0211892	0.025179436	0.022426928	0.012455593	0.047803461	0.034385975	0.000682379	0.000816952	0.021007985	0.018105322	
Emerging Market Equity	0.022540671	0.022932769	0.02676246	0.020998896	0.034385975	0.070238108	0.000721196	0.00035139	0.028541038	0.024359662	
World ex US											
Government Bonds US	0.001282133	0.001129025	0.001331129	0.00139965	0.000682379	0.000721196	0.001492746	0.000174493	0.000781686	0.000275434	
Government Bonds	0.000639146	0.000637483	-6.13407E-05	0.001129919	0.000816952	0.00035139	0.000174493	0.00317777	-0.000220567	-0.00040458	
US Small Cap Equity	0.021995743	0.021525515	0.01992048	0.014615193	0.021007985	0.028541038	0.000781686	-0.000220567	0.030544706	0.022198219	
Canada Small Cap Equity	0.014487984	0.020925823	0.015084307	0.013269484	0.018105322	0.024359662	0.000275434	-0.00040458	0.022198219	0.027264883	
Europe Small Cap Equity	0.015996942	0.01699617	0.024222375	0.016454084	0.020338585	0.029751271	0.000722451	-0.000305931	0.019909398	0.016828712	
Japan Small Cap Equity	0.008297738	0.009903771	0.012369553	0.04145087	0.012782527	0.01698524	0.000384463	0.001581675	0.009776112	0.011107066	
Far East (ex Japan) Small											
Cap Equity US non-	0.015891457	0.018193865	0.017482193	0.015243983	0.034834323	0.035611704	0.001340323	0.000270974	0.019729778	0.017745211	
Government	0.000005040	0.000700770	0.00044004	0.004000440	0.00400004	0.00000.4400	0.000477000	0.004005007	0.700005.05	0.000405740	
Bonds Canadian	0.000835042	0.000708778	0.00011081	0.001600119	0.00100884	0.000634129	0.000177892	0.004095207	-8.72889E-05	-0.000425749	
non- Government Bonds	0.00122175	0.001924321	0.00023592	0.000760708	0.000749605	0.000806136	0.0004931	4.50838E-05	0.001904461	0.002124816	
European non- Government											
Bonds Japanese	-0.000606653	-0.000926659	-0.000952214	-0.000828725	-1.07043E-05	-0.001331171	0.000528932	4.67012E-05	-0.000928047	-0.001275246	
Non- Government Bonds	-0.000858462	-0.000492399	-0.00069268	-0.000193933	-0.000174956	-0.000319853	0.000251943	6.10316E-05	-0.000897913	-0.000271308	
Australian	5.00000402	5.000432033	0.00000200	3.000130333	3.000174000	5.000013000	5.000201040	5. 100 IOL-00	3.000037313	3.00027 1000	
Non- Government Bonds	0.00032262	0.001078378	-0.000208789	-2.2696E-05	0.000687772	6.60728E-05	0.000442773	5.6121E-05	0.000918642	0.00128725	
Global Property	0.010891627	0.012096137	0.009478896	0.004976347	0.0127604	0.009392064	0.001510927	0.000548618	0.009693916	0.007077682	
Global High Yield	0.00831942	0.009478945	0.008548052	0.007228151	0.008174009	0.0150609	-6.58251E-05	-3.97589E-05	0.011341094	0.009689032	
Global Emerging Market Debt											
(Sovereign)	0.014580761	0.018103196	0.014826792	0.01437646	0.019905854	0.031383325	0.000826844	0.00025547	0.017172428	0.015882963	

US Large	Europe Small Cap Equity	Japan Small Cap Equity	Far East (ex Japan) Small Cap Equity	US non- Government Bonds	Canadian non- Government Bonds	European non- Government Bonds	Japanese Non- Government Bonds	Australian Non- Government Bonds	Global Property	Global High Yield	Global Emerging Market Debt (Sovereign)
Cap Equity Canadian	0.015996942	0.008297738	0.015891457	0.000835042	0.00122175	-0.000606653	-0.000858462	0.00032262	0.010891627	0.00831942	0.014580761
Large Cap Equity	0.01699617	0.009903771	0.018193865	0.000708778	0.001924321	-0.000926659	-0.000492399	0.001078378	0.012096137	0.009478945	0.018103196
Europe Large Cap Equity	0.024222375	0.012369553	0.017482193	0.00011081	0.00023592	-0.000952214	-0.00069268	-0.000208789	0.009478896	0.008548052	0.014826792
Japan Large Cap Equity Far East ex	0.016454084	0.04145087	0.015243983	0.001600119	0.000760708	-0.000828725	-0.000193933	-2.2696E-05	0.004976347	0.007228151	0.01437646
Japan Large Cap Equity	0.020338585	0.012782527	0.034834323	0.00100884	0.000749605	-1.07043E-05	-0.000174956	0.000687772	0.0127604	0.008174009	0.019905854
Emerging Market Equity	0.029751271	0.01698524	0.035611704	0.000634129	0.000806136	-0.001331171	-0.000319853	6.60728E-05	0.009392064	0.0150609	0.031383325
World ex US Government Bonds	0.000722451	0.000384463	0.001340323	0.000177892	0.0004931	0.000528932	0.000251943	0.000442773	0.001510927	-6.58251E-05	0.000826844
US Government											
Bonds US Small Cap Equity	-0.000305931 0.019909398	0.001581675		0.004095207 -8.72889E-05	4.50838E-05 0.001904461	4.67012E-05 -0.000928047	6.10316E-05 -0.000897913	5.6121E-05 0.000918642	0.000548618		
Canada Small Cap Equity	0.016828712	0.011107066		-0.000425749	0.002124816	-0.001275246	-0.000271308	0.00128725	0.007077682	0.009689032	0.015882963
Europe Small Cap Equity	0.026866835	0.014698153	0.018152278	-0.000127806	0.000217883	-0.001137233	-0.000364915	-0.000489986	0.007046911	0.01120438	0.014253485
Japan Small Cap Equity	0.014698153	0.05255377	0.012318571	0.001533321	0.001438227	-0.0003717	-0.000165383	0.000335747	0.003387357	0.005267032	0.00733551
Far East (ex Japan) Small Cap Equity	0.018152278	0.012318571	0.038173512	0.00033123	0.000928857	-0.000101612	0.000290021	0.000804216	0.008531374	0.00720259	0.021033739
US non- Government Bonds	-0.000127806	0.001533321	0.00033123	0.006216332	6.68401E-05	4.45865E-05	8.2468E-05	6.47199E-05	0.000735325	-3.93424E-05	0.000428886
Canadian non- Government Bonds	0.000217883	0.001438227	0.000928857	6.68401E-05	0.001402911	0.000549135	-2.25514E-05	0.000853361	0.000817285	0.000886136	0.002536192
European non- Government Bonds	-0.001137233	-0.0003717	-0.000101612	4.45865E-05	0.000549135	0.000676263	-3.91636E-06	0.00041461	0.000293079	0.000132773	-0.000183935
Japanese Non- Government Bonds	-0.000364915	-0.000165383	0.000290021	8.2468E-05	-2.25514E-05	-3.91636E-06	0.000697117	0.000169086	0.00058234	-9.24781E-07	6.03702E-05
Australian Non- Government	0.0004000000	0.0000057	0.0000045	6 474005 33	0.000055555	0.00047.55	0.000405555	0.0040447	0.004005711	0.000405500	0.000440444
Bonds Global Property	-0.000489986 0.007046911	0.000335747				0.00041461		0.001044746	0.001065711		
Global High Yield Global	0.01120438	0.005267032						0.000195592	0.00335254	0.007396017	0.008564286
Emerging Market Debt (Sovereign)	0.014253485	0.00733551	0.021033739	0.000428886	0.002536192	-0.000183935	6.03702E-05	0.002118111	0.007975982	0.008564286	0.0311519

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January 20XX

Strategic Asset Allocation Analysis

Government of Country X Ministry of XXX

MERCER

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1

Introduction

Assignment

Law

Fiscal Policy

Investment Objectives

Introduction

Assignment

The Ministry of XXX of Country X retained Mercer Investment Consulting, Inc. (Mercer) to assist in the development of suitable asset allocation strategies for the Fund X and Fund Y, which were established by the Government of Country X in 20XX to help ensure the sustainability of social spending over time a improve Country X's economic competitiveness. We are pleased to submit this report on strategic asset allocation.

To develop candidate investment strategies for the aforementioned Funds, we used a combination of mean-variance and stochastic modeling (Monte-Carlo simulations).

This asset allocation study reflects explicit inclusion of cash flows modeled for both Funds during the 10 year period for which Monte-Carlo projections were performed. Projected liabilities for the Fund X were not modeled quantitatively, but their anticipated characteristics were taken into account qualitatively in evaluating candidate strategies. For the Fund Y, we developed assumptions for the expected liabilities of this Fund working in conjunction with the Ministry of XXX. These assumptions appear in section 4 of this report.

Underlying investments in the candidate strategic allocations were modeled as being made globally, but excluding investments in Country X and in the Currency X. We understand that the policy decision to prohibit investment of these funds in Country X and the Currency X, which was taken before the study commenced, is based on the desire to diversify away from the Government's primary sources of income (GDP growth and the commodity).

Following discussion of the pros and cons of adopting alternative frames of reference in terms of currency, including the Currency X or a trade weighted, consumption weighted, or other basket of foreign currencies, the Ministry of XXX ultimately directed Mercer to perform the study in US dollar (USD) terms. We do not believe the selection of the USD as the unit of account for this study had a major impact on the content of the recommended portfolios, because the asset classes were limited to global asset classes, with the regional and country allocations for each asset class fixed for modeling purposes at their market capitalization weights. Since the underlying currency allocation of the global developed market asset classes is similar, optimizing in USD is unlikely to have driven a preference of the model for one asset class over another that would not be consistent with the result if modeling had been performed in a different currency or basket of currencies.

Sensitivity analysis was performed by re-optimizing for both Funds in Currency X terms. This sensitivity analysis confirmed Mercer's view that the contents of the recommended portfolios would not be highly sensitive to the currency frame of reference.

Although we do not believe the results of this study – in terms of the content of the recommended portfolio – are highly sensitive to the currency in which the study was conducted, we discuss below some of the considerations that factored into selection of the USD as the unit of account for this study.

- There is a basic conflict between optimizing results in Currency X terms and having the Funds invest in a way that diversifies against local economic results, as local economic performance drives the appreciation or depreciation of the Currency X. If portfolios were optimized in Currency X terms, it would be more difficult to ensure the resulting portfolios maintain a low correlation with Country X GDP growth and the commodity prices.
- Modeling in a currency that does not have a strong relationship with the global asset classes being modeled may also result in poorly diversified portfolios. Even though the Country X economy is open, it is relatively small as a proportion of the global economy. Historical data based on which the relationship between the Currency X and the asset classes of interest, none of which by definition included any Currency X-denominated assets, is limited, and of limited value given the pace and scope of capital markets and economic evolution in Country X and globally in recent decades. The USD on the other hand does have well-specified and reasonably well understood relationships with returns to the global asset classes considered in the analysis. And in fact the US domestic market comprises a substantial portion of global market capitalization for each of these asset classes.
- The currency in which optimization is made should, in Mercer's opinion, reflect the anticipated frame within which results will be evaluated and communicated. The USD is a reasonable, readily comprehensible proxy for Country X's trade- or consumption-weighted basket of currencies. If the focus of evaluation and communication were in Currency X terms, then most of the volatility would be driven by Currency X exchange rates, whic would make the evaluation of performance more problematic. As such, we believe optimization in the USD is an appropriate means for developing candidate portfolios, assuming communication of results and evaluation of performance will also be made in USD terms. Although in theory a trade or consumption-weighted basket might have been employed, this would have complicated analysis without (for reasons detailed in the body of the report) materially affecting the content of the recommended portfolios. And, it is not practical to communicate or evaluate the investment results in a readily comprehensible way to the public, if a currency basket is used as the unit of account.

Many models of the capital markets only focus on mean-variance analysis. Efficient frontier modeling, for example, is a mean-variance approach. "Simple" mean-variance analysis is used to identify candidate portfolios which achieve the highest expected return for a given level of expected risk, where risk is defined by the standard deviation or volatility of returns. Surplus optimization is another type of mean-variance analysis, in which volatility of funded status of the assets against the projected liabilities is the measure of risk. Mean-variance approaches are quite acceptable for certain situations, but in Mercer's opinion, they fail to provide satisfactory results in detailed modeling of the complex interaction among interest rates, inflation, and the return of asset classes exposed to multiple risk factors. Additionally, mean-variance modeling does not take into account the impact of cash flows - both positive and negative - on ultimate portfolio values, and does not adjust for the "path dependent" nature of capital market returns. An example of path dependency is that returns for fixed income are partially dependent on yields at the beginning of the period. Once interest rates are high, subsequent capital market returns tend to be high as well - and vice versa, in low interest rate environments, subsequent returns tend to be lower, all else being equal.

The study incorporated a set of mean-reverting, serially correlated equations to determine inflation, economic growth, and interest rates, among other factors. Although more complex than a mean-variance approach, the resulting Monte-Carlo model permits great flexibility and in Mercer's opinion encompasses in a more realistic manner the multifaceted, dynamic nature of the capital markets.

The initial stage of the analysis focused on mean-variance analysis to identify candidate portfolios that exhibited appropriate levels of risk for each Fund, consistent with the risk parameters provided by the Ministry of XXX. The risk tolerance levels provided for each Fund were as follows:

- Fund X Fund: Maximum loss of 1%, 2%, and 5% of the Fund in USD terms in any given year, at the 95th percentile (one-in-twenty downside outcome) of the projected distribution of returns:
- Fund Y Fund: Maximum loss of 2%, 5%, and 10% of the Fund in USD terms in any given year at the 95th percentile.

Once the candidate portfolios were identified based on the parameters above as a general guide, we conducted stochastic (Monte-Carlo) analysis to simulate the performance of the asset mixes by modeling across 1000 economic scenarios for a period of 10 years (from 20XX to 20XX). The forward-looking assumptions used in the analysis can be found in section 4 of this report. The historical results for the economic and asset class variables, as well as a summary of future expectations based on Monte-Carlo simulation results (reported at the median) can be found in section 6 of this report. In addition, the Ministry of XXX has received the entire data set, including distribution of results from the 5th to the 95th percentiles.

For purposes of the Fund X the simulated cash flows and investment results were derived from Monte-Carlo simulations of several key economic variables, including Currency X growth, changes in the commodity prices, interest rates, and inflation levels. The analysis assumes that 100% of the prior year's investment returns in Currency X terms are withdrawn from the Fund each year to be used as structural income, limiting the Fund's potential for capital growth over time. We understand this policy might change in the future; however, any possible changes to this were not reflected in the analysis presented in this report.

For the Fund Y, the analysis assumes cash inflows or contributions equivalent to a range of 0.2% to 0.5% of prior year Country X GDP. In cases in which the simulations result in strong economic activity, as defined by local GDP and/or the commodity prices that are above expectations, the model allocates a higher proportion of contributions within the aforementioned range. By contrast, during periods of economic and the commodity price underperformance against expectations, the model specifies a minimum contribution of 0.2% of GDP. For the selection of candidate portfolios, we modeled this Fund in assetonly space based on the risk parameters described above and also using funded status optimization. The funded status optimization was used as the basis for the selection of candidate portfolios. This required the development of liability assumptions for this program.

The Fund Y is not expected to experience any withdrawals until the year 2017 when liability cash outflows will begin to affect this program. We developed liability assumptions working in conjunction with the Ministry of XXX, considering a number of factors, including: projected cash outflow data provided from 20XX to 20XX and an assumed projected liability growth from 20XX to 20XX not exceeding 6%; a projected discount rate to calculate the present value of future outflows; a projected liability duration; and the impact of cash flow activity considering the projected outflows and contributions equivalent to 0.2% of Country X GDP.

The asset classes considered in the study are identical for both Funds, but the candidate alternative strategic allocations are different, as each of the Funds have different objectives, constraints, and characteristics. We selected the same asset class variables for both programs intentionally to help maximize cost savings opportunities once the Ministry of XXX is prepared to implement the strategies for each Fund. We anticipate cost savings should be realized by utilizing the same investment managers for both Funds in the eventual implementation of the strategies, due the economies of scale that can be achieved considering a larger asset base and the gradual decrease in asset-based fees in the typical fee schedules.

The following sections of this report include important background information as well as key observations, recommendations, and the quantitative and qualitative analysis on which the recommendations were based.

Law

The Government of Country X enacted a law in September of 20XX, known as the Law, which created the Fund X and the Fund Y to help ensure the sustainability of social spending over time and improve Country X's economic competitiveness.

The Fund X was created to act as a financial "buffer" to avoid drastic revisions to fiscal spending as a result of negative short-term economic cycles. Its main function is to accumulate annual fiscal surpluses net of the required contributions designated principally to the Fund Y and to the recapitalization of the Central Bank of Country X. The Fund X will also provide necessary resources to cover fiscal spending in the event of a fiscal deficit due to declining economic fundamentals. In effect, the Fund X will accumulate surpluses during times of strong local economic activity and will provide necessary resources to finance fiscal spending during periods of declining economic growth

The investment policy of the Fund X is relatively flexible; the only investment restriction is no investments in Country X (or investments denominated in the Currency X) shall be made However, it is important to take into consideration that the investment returns generated by the Fund X are withdrawn and treated as part of structural income to cover fiscal expenditures.

The Fund Y was designed to finance up to one-third of the fiscal expenditures associated with the minimum pension and assistance benefits guaranteed by the Government. The contingent liabilities associated with these benefit guarantees are expected to grow by an estimated 33% relative to the structural growth of the economy by the year 20XX². The contribution source for this Fund will be derived from the effective fiscal surplus, which will be equivalent to a range of 0.2% to 0.5% of the prior year's GDP, with a minimum contribution of 0.2%. No withdrawals will be permitted from the Fund Y until 2017. The permissible investments of this program must follow the provisions under law Number X - Article X. All investment gains, including capital appreciation and capital income, will be re-invested in the Fund Y.

Fiscal Policy

The objective of Country X's Fiscal Policy is to contribute to the macroeconomic stability of the country and provide public benefits that increase the social opportunities as well as the protection of its citizens. This policy is carried out in accordance with Country X's structural balance concept, which aims to protect Government spending from the effects of economic and the commodity price cycles - the avoidance of a pro-cyclical bias in the management of public finances. Currently, the policy is based on the goal of achieving a yearly structural surplus of 1% of GDP. The target surplus will be adjusted to 0.5% of GDP starting in the year 20XX.

² Source: Ministry of XXX

While actual Government revenues may go up and down in tandem with local economic cycles (declining during recessions and growing during economic booms), fiscal expenditures do not follow this pattern because they follow the evolution of the economy's medium term productive capacity. The structural surplus rule is intended to smooth out the impact of higher the commodity prices on royalty collections coming in from the state-owned commodity Company XYZ and taxes collected from other private mining companies.

The rationale for the adoption of the Fiscal Policy framework, which mandates a national budget surplus equivalent to 1% of GDP (not structural balance between fiscal income and fiscal expenditures), was derived from three key fiscal risk factors, including:

- 1. The expected growth of the fiscal liabilities arising from the minimum pension and assistance benefits guaranteed by the Government;
- 2. The recapitalization of the Central Bank of Country X, due to the acquisition of private sector debt following the local banking crisis of 19XX;
- 3. External vulnerabilities from Government income, which is principally denominated in local currency, and debt which is mainly denominated in foreign currency. A sudden depreciation of the Currency X would result in much higher costs to service foreign currency debt in such an environment. This is important considering the Country X economy is open and relatively small as a proportion of the global economy.

Government income is derived from two main sources, tax revenues and the commodity-related revenues. Tax revenues represented an average of approximately XX% of Government revenues from 19XX to 20XX, and the commodity-related revenues represented an average of approximately 10% during the same period³. Fiscal expenditures are set so that the difference between expected/structural Government revenues (which are estimated by a panel of experts in various disciplines in June-July each year) and actual government expenditures is equal to 1% of GDP.³ Fiscal expenditures are planned on an annual basis utilizing this process.

Use of Prospective Fiscal Surpluses: By policy, at least 0.2% (and, should the cash surplus allow, up to 0.5%) of the prior year's GDP is designated to the Fund Y and up to 0.5% may be assigned to the gradual recapitalization of the Central Bank of Country X for the next five years⁴. Once these fiscal expenditures are covered, the rest of the net surplus is allocated to the Fund X. If actual revenues come in below expected revenues, by structural definition this constitutes a deficit, in which case resources will be used from the Fund X to cover fiscal expenditures.

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³ Source: Ministry of XXX – 'Country X's Fiscal Policy Framework' – Ministry of Finance, Country X March 20XX.

⁴ Source: 20XX International Monetary Fund – Country: 20XX Article IV Consultation – Staff Report; Staff Supplement; Public Information Notice on the Executive Board Discussion; and Statement by the Executive Director of Country X.

Investment Objectives

The objective of Country's Fiscal Policy is to minimize, to the extent possible, the impact the volatility of the business cycle may have on fiscal spending. Consistent with this objective, and in an effort to disassociate the value of the Fund X and Fund Y in relation to local economic cycles and the volatility of the commodity prices, the specific investment objectives reflected in this study are to:

- Develop suitable asset allocation strategies for both Funds, which exhibit a low correlation relative to the main sources of Government revenues (the commodity price volatility and the cyclicality of local GDP growth);
- Identify portfolios whose reward and risk characteristics maximize risk-adjusted return potential;
- Improve the efficiency of both Funds relative to the theoretically optimal risk/return spectrum, identifying asset classes which provide further diversification of investments;
- Identify potential investment opportunities considering the amendment of current investment policy parameters for the Fund Y; and
- Identify candidate asset allocation strategies that meet the liquidity and risk parameters expressed by the Ministry of XXX considering current investment restrictions where applicable.

In order to meet these objectives, we performed Monte-Carlo simulations to test the behavior of candidate portfolios under different economic environments, with a particular focus on pursuing low correlation between Country X GDP growth and the commodity prices, and returns to the candidate portfolios.

While the level and behavior of GDP is an important determinant of Government revenues, the volatility of Country X GDP has been low relative to the historical volatility of the commodity prices over the last decade. For example, royalties and taxes related to the commodit production represented an average of 10% of total Government revenues from the period of 1994 to 2006; however, it represented only 3% in 2002 and 34% in 2006. In the forward-looking stochastic projections, the average volatility of Country X GDP growth at the 50th percentile was 3% in nominal terms over the 10-year projection horizon. By comparison, the volatility of the commodity prices was 26% over the same time horizon. In this context, volatility of the commodity prices can reasonably be expected to remain more important, compared to volatility of GDP, as a determinant of actual revenues received by the Government.

Since the commodity is one of the main exports of Country X, it might be expected that there would a high correlation between the commodity price and Country X GDP growth. However, this is not the case in the historical data (1994 to 2006). Using both coincident and lagging correlation time-periods, the finding of low historical correlation was confirmed.

Services Provided by Mercer Investment Consulting, Inc.

⁵ Source: Ministry of XXX – 'Country X's Fiscal Policy Framework' – Ministry of Finance, Country March 2007.

We used a higher correlation for the forward-looking projections than the historical values, because we believe that the commodity has become more important as a contributor to the Country X economy, and that some increased leakage from the commodity boom into other sectors of the economy should be expected going forward.

Another key conclusion is that Country X GDP growth and the commodity prices are likely to exhibit low correlation relative to the asset classes considered in the strategic asset allocation analysis. Historical correlations have ranged from -0.15 to 0.23 for the commodity and 0.00 to 0.32 for GDP growth over the last 15 years against the asset classes modeled. Therefore, we used forward-looking projections with low correlations for both of these variables against the asset classes modeled. Accordingly, all of the portfolios considered in the analysis exhibited a low correlation relative to Country X GDP growth and the commodity price volatility.

Section 2 of this report profiles the recommended asset allocations for each of the Funds and discusses some key observations. Section 3 describes the two analytical approaches we adopted. Section 4 provides the output of the mean-variance analysis, while section 5 includes the Monte-Carlo simulation results for each of the recommended portfolios along with key observations. Section 6 provides summary quantitative output for each of the variables considered in the analysis (on a forward-looking and historical basis), and section 7 provides testing results (also on a forward-looking and historical basis) of the recommended portfolios. The Appendix, section 8, provides detailed reference information.

2

Executive Summary

Background

Observations and Recommendations

Executive Summary

Background

The goal of this strategic asset allocation analysis is to identify suitable portfolios that exhibit a low correlation relative to the principal sources of Government revenues at acceptable levels of risk. This is of crucial importance considering Country X's Fiscal Policy Framework, which defines annual fiscal expenditures as a result of the difference between structural income and effective income. We profile several candidate strategic asset allocations for each Fund, varying by risk level, to provide an overview of the investment opportunity set offered by different investment structures in terms of their long-term return potential and risk characteristics.

For the Fund X, we have identified a recommended mix which falls within the risk parameters given by the Ministry of XXX. For Fund Y, we profile two candidate asset allocations, one reflecting current investment policy parameters (reflecting a combined maximum exposure of 25% to stocks and corporate bonds) and one that relaxes these parameters to illustrate the opportunity set afforded by increasing investments in global equities and global corporate bonds. The overall objective is to identify portfolios that maximize return potential for both programs considering the maximum tolerable risk defined by the Ministry of XXX in the maximum loss scenarios detailed in Section 1 of this report.

The next sub-section of the Executive Summary provides our key observations and recommendations for Fund X and Fund Y.

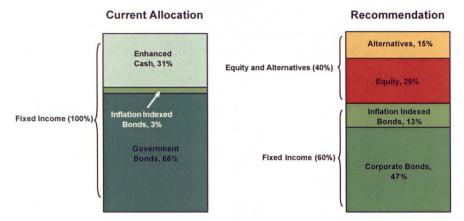
Observations and Recommendations

Fund X

We understand that the only explicit investment restriction governing this Fund in terms of its permissible investments is a prohibition on investing in Country X or in securities denominated in the Currency XP. Given the role of this Fund in the Country X economic system, and in particular the intention to spend each year's income, the current 100% fixed income profile, which affords a high degree of liquidity, was a reasonable starting position for investment.

We believe there are significant opportunities to enhance diversification and increase potential investment returns over the long-term. We concluded that a maximum exposure of 30% to equities and a maximum exposure of 15% to alternatives for the Fund was appropriate, given both spending policy objectives and the low risk tolerance levels conveyed to us by the Ministry of XXX.

The following exhibit depicts the Fund X's current allocation in comparison to the recommended portfolio.



The recommendation above exhibits a higher expected return profile with meaningful allocations to fixed income, equity, and alternative investments. This asset allocation provides more potential for higher returns over the long term without violating current risk parameters.

The summary table on the following page provides key statistical characteristics for the current portfolio and the recommended asset mix. These characteristics were based on the median values of the Monte-Carlo simulation results for the next ten years.

Summary Results

	Current Asset Allocation	Recommendation	
Global Equity	0%	25%	
Global Fixed Income - Government - Short/Intermediate	66%	0%	
Global Fixed Income - Government - Long	0%	0%	
Global Fixed Income - Corporate - Short/Intermediate	0%	30%	
Global Fixed Income - Corporate - Long	0%	17%	
Global TIPS	4%	13%	
Global Fixed Income - Corporate - Short/Intermediate Global Fixed Income - Corporate - Long Global TIPS Global Cash Global Private Equities	30%	0%	
Global Private Equities	0%	5%	
Global Real Estate	0%	3%	
Global Infrastructure	0%	2%	
Global Absolute Return/Opportunistic	0%	5%	
	vth) 0.05	0.12	
Correlation (Nominal Portfolio Returns; Nominal GDP Growth) Correlation (Nominal Portfolio Returns; Real Correlation (Nominal Portfolio Returns; Nominal Price) Correlation (Real Portfolio Returns; Nominal Price) Portfolio Expected Nominal Returns (USD) Portfolio Nominal Returns Volatility (USD) Lowest Annual Returns Volatility (USD) Change in Nominal Returns From Current Allocation Portfolio Expected Nominal Returns Portfolio Expected Nominal Returns Portfolio Nominal Returns Volatility Duration	-0.03	0.09	
Correlation (Nominal Portfolio Returns; Nominal Price)	-0.03	0.23	
Correlation (Real Portfolio Returns; Nominal Price)	-0.05	0.21	
Portfolio Expected Nominal Returns (USD)	4.70%	6.78%	
Portfolio Expected Nominal Returns (USD) Portfolio Nominal Returns Volatility (USD) Lowest Annual Return Observed from 2008 to 2017 (95th Percel Change in Nominal Returns From Current Allocation	2.16%	7.16%	
Lowest Annual Return Observed from 2008 to 2017 (95th Percei	ntile) 1.00%	-4.48%	
Change in Nominal Returns From Current Allocation	-	2.08%	
Change in Nominal Risk From Current Allocation		5.00%	
Portfolio Expected Nominal Returns	5.98%	8.12%	
Portfolio Nominal Returns Volatility	12.24%	14.30%	
§ Duration	1.35	1.91	
Liquidity Ratio	9.90	7.86	
5-Year Annualized Returns (USD)	3.17%	9.22%	
5-Year Annualized Volatility (USD) 5-Year Annualized Returns	0.75%	4.24%	
5-Year Annualized Returns (USD) 5-Year Annualized Returns 5-Year Annualized Returns 5-Year Annualized Returns	-2.09%	3.65%	
5-Year Annualized Volatility	9.03%	6.98%	

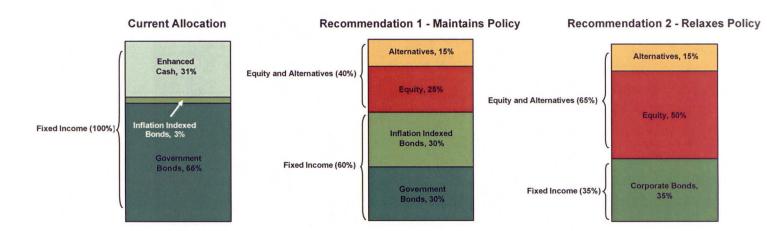
Observations (in USD terms)

- The analysis suggests that the current allocation can provide an expected annualized nominal return of 4.70% with a standard deviation of 2.16% over the next ten years. In addition, it does not exhibit a loss at the 95% confidence interval due to its conservative profile.
- The recommended portfolio exhibits an expected nominal return of 6.78% and a standard deviation of 7.16%. This portfolio offers a premium of 208 basis points in expected return over the current allocation. The lowest return observed at the 95th percentile distribution of the 10-year Monte-Carlo simulations is -4.48%. This portfolio exhibits characteristics that fall within current acceptable risk parameters as defined by the Ministry of XXX.
- The recommended mix offers attractive diversification attributes, providing a 40% exposure to global equities and alternative investments (25% and 15%, respectively) to enhance alpha potential, and a 60% allocation to fixed income instruments for purposes of diversification and capital preservation given the role of the Fund X.

Fund Y

To establish candidate asset allocations for this Fund, we gave consideration to the current maximum investment restriction of 25% to stocks and corporate bonds, combined. We believe that raising this allocation to higher levels would be prudent and reasonable if permitted. Unlike the Fund X, the Fund Y is not expected to experience any outflows for the next ten years. Therefore, adopting a more aggressive asset allocation would be prudent in order to improve growth prospects for this Fund over this time period.

The following exhibit depicts the Fund's current allocation and the two candidate allocations we have recommended in this analysis.



The summary table on the following page provides key statistical characteristics for each of the portfolios profiled above.

Summary Results

		Current Asset Allocation	Recommendation 1 (Maintains Policy)	Recommendation 2 (Relaxes Policy)
	Global Equity	0%	25%	50%
	Global Fixed Income - Government - Short/Intermediate	66%	0%	0%
	Global Fixed Income - Government - Long	0%	30%	0%
Asset Allocation	Global Fixed Income - Corporate - Short/Intermediate	0%	0%	35%
ocal	Global Fixed Income - Corporate - Long	0%	0%	0%
Ĭ,	Global TIPS	3%	30%	0%
set	Global Cash	31%	0%	0%
As	Global Private Equities	0%	5%	5%
	Global Real Estate	0%	5%	5%
	Global Infrastructure	0%	2%	0%
	Global Absolute Return/Opportunistic	0%	3%	5%
ts	Correlation (Nominal Portfolio Returns; Nominal GDP Growth)	0.05	0.13	0.13
Simulation Results alues)	Correlation (Nominal Portfolio Returns; Real GDP Growth)	-0.03	0.09	0.10
n Re	Correlation (Nominal Portfolio Returns; Nominal Price)	-0.03	0.22	0.27
tio	Correlation (Real Portfolio Returns; Nominal Price)	-0.05	0.22	0.26
nula es)	Portfolio Expected Nominal Returns (USD)	4.69%	6.80%	7.55%
Sir	Portfolio Nominal Returns Volatility (USD)	2.14%	7.70%	10.67%
Carlo dian Va	Lowest Annual Return Observed from 2008 to 2017 (95th Percentile)	1.01%	-5.37%	-8.97%
nte Carlo Simul (Median Values)	Change in Nominal Returns From Current Allocation	-	2.12%	2.86%
Summary Monte (Med	Change in Nominal Risk From Current Allocation	-	5.56%	8.53%
2	Portfolio Expected Nominal Returns	5.97%	8.17%	8.92%
ma	Portfolio Nominal Returns Volatility	12.23%	14.61%	16.59%
mn _s	Duration	1.34	2.55	0.63
	Liquidity Ratio	9.90	8.26	7.90
- v	5-Year Annualized Returns (USD)	3.16%	9.76%	11.89%
istorica	5-Year Annualized Volatility (USD)	0.74%	4.49%	7.14%
Historical Results	5-Year Annualized Returns	-2.10%	4.16%	6.18%
	5-Year Annualized Volatility	9.03%	7.22%	6.79%

Observations (in USD terms)

- The current allocation provides an expected nominal return of 4.70% with a standard deviation of 2.16%. This portfolio does not experience a loss at the 95% probability distribution confidence level due to its conservative profile, investing primarily in enhanced cash and government bonds. The asset/liability optimization exhibits a surplus return of -5.81% and a surplus standard deviation of 50.70%. The alternative recommendations provide more attractive characteristics in terms of absolute and relative return potential, as well as current tolerable risk parameters.
- Recommendation 1 maintains the current investment policy guidelines, permitting a total maximum allocation of 25% to stocks and corporate bonds. The recommendation offers an expected return premium of 212 basis points relative to the current allocation, and risk characteristics that fall within tolerable parameters as defined by the Ministry of XXX. Based on the assumed liability projections, the funded status optimization yields a surplus return of -3.32% and a surplus standard deviation of 51.52%.

Recommendation 2 considers the amendment of current policy guidelines to permit a more significant exposure to global equity and global corporate bonds. This relatively aggressive portfolio does not violate current risk parameters for Fund Y; however, it does not provide a surplus return relative to the expected return of the liabilities, which suggests even a more aggressive allocation may be warranted. However, this decision should be driven by a careful evaluation of the evolution of the liabilities over time as this data becomes readily available. This asset mix offers an expected return premium of 286 basis points relative to the current. The asset/liability optimization offers a surplus return of -2.23%, which serves as the most optimal result considering (1) the expected liability growth and (2) current risk parameters.

Other Considerations

The Fund Y is not expected to experience any withdrawals until the year 2017, but liability cash flows will begin to affect this program in the year 2017. We believe that incorporating the economic sensitivities of the relevant liabilities in determining strategic asset allocation is important as a component of determining how much risk can be afforded given the characteristics of the expected outflows and, conversely, how much time and opportunity there may be to focus mainly on capital growth rather than mainly on capital preservation strategies. The funded status optimization suggests it is important to shift the focus away from capital preservation strategies towards capital appreciation. The more aggressive recommendation - Recommendation 2, which has a higher allocation to stocks and corporate bonds relative to Recommendation 1, provides better results in asset/liability space, albeit the expected surplus return remains in negative territory considering current risk parameters (not exceeding an annual loss of 10% assuming a normal distribution of returns). This strategy can only be implemented if current policy guidelines are amended to allow a higher allocation to equities and corporate bonds. A more aggressive portfolio would be needed to achieve a positive surplus return, but this would require the Ministry of XXX to relax its current risk parameters. Recommendation 2 is more closely aligned with the broad asset allocation of other national pension funds in other areas of the world (please see Appendix).

Implementation Considerations

Transition of Assets to New Strategic Allocations

The analysis is strategic in nature and focuses exclusively on the allocation of assets among broad global asset classes (ex Country X) conforming to the objectives communicated to us by the Ministry of XXX. It is important to highlight certain issues pertaining to the portfolio structuring implementation process once the strategic asset allocation is identified for both the Fund X and Fund Y programs.

A practical process may involve providing exposure to the new assets classes considered in the strategic analysis passively. This can be followed by the selection of active investment managers in appropriate segments of the overall portfolio, following the results of a sound portfolio structure review.

The following factors should be considered in the portfolio structuring process:

- Current investment policy guidelines
 - Consideration of permissible investments and applicable parameters;
- Active versus passive management
 - Index strategies make sense in those markets that are highly efficient (i.e., the US large cap segment of the equity market)
 - Active managers have the potential to add value in relatively inefficient areas of the market (i.e., some developed markets, small capitalization equities, emerging markets, alternatives)
- Regional, country, and currency exposure
 - Pursuing a market weight in the corresponding asset classes versus opportunistic allocations implemented by a tactical asset allocation overlay strategy;
 - Global versus regional managers
 - Some regional managers may have stronger dedicated resources employed in specific regions of the world, as opposed to other managers with global scope.
 However, there are some global managers with significant local resources focused on each region as well;
- Overweighting the commodity consumers versus the commodity producers to further reduce the correlation of the portfolio to the volatility of the commodity prices (i.e., the commodity producing companies will be at a disadvantage when the commodity prices decline, but the commodity consumers should benefit in this environment);
- Manager selection
 - Investment criteria
 - Forward-looking assessment of the performance prospects of candidate investment managers
 - Fees:
- Custody arrangements;
- Monitoring.

These considerations can be addressed once the strategic asset allocation is adopted for both programs.

In addition, the process by which the assets are transitioned from the current conservative investments to the selected new investment strategies is important, particularly for a government-affiliated fund that wishes to be open and transparent in how it conducts its operations.

There are a number of considerations that must be taken into account, including:

- Market timing element in moving into the new asset classes;
- Legal issues;
- Political issues:
- Headline risk:
- Transparency (reporting);
- Liquidity issues; and
- Risk controls.

In theory, the transition to the new asset allocation should take place in one step as soon as possible. In practice, however, we believe conservatism must be exercised in this process given the important considerations listed above. We believe that pursuing the transition in 5% increments (as a proportion of total assets) every calendar quarter (or any non-calendar time period prudent to the specific needs of Country X) would be appropriate and conservative. Hence, we recommend achieving the new optimal asset allocation in two stages, as follows:

Stage 1

Consideration of liquidity issues associated with alternative investments: To achieve investment efficiency, we recommend considering only the most liquid asset classes in the initial stage of implementation These would exclude alternative investments but would include traditional investments (publicly traded fixed income and equities).

Stage 2

Consideration of additional diversification: Once the traditional asset classes are funded to appropriate levels, the transition into alternative investments should be accomplished to introduce the long-term diversification and expected return potential of these asset classes.

We have included a suggested implementation strategy in the Appendix (item XI), which includes the suggested transition of the assets and the potential timing involved to complete it. This process can be achieved within approximately two to two and one-half years for both Funds, considering the candidate strategic allocations we have selected as a result of the analysis. We created two suggested implementation strategies for Fund Y – one of them assumes no immediate relaxation to the 25% constraint on equities and corporate bonds, and the other one relaxes these policy restrictions, corresponding to the more aggressive asset allocation recommendation for this Fund (Recommendation 2).

3

Strategic Asset Allocation Approach

Mean Variance Analysis Stochastic Analysis

Strategic Asset Allocation Approach

Mean Variance Analysis

We utilized mean-variance analysis to identify candidate optimal portfolios at various levels of risk. While the mean-variance analysis is relatively limited in that it only considers one risk factor, the volatility of returns, and assumes a normal distribution of returns, it provides a reasonable guide in terms of the trade-offs of both returns and risk. In addition, the mean variance statistical output also helps us identify diversification opportunities by understanding the relationship between the Funds' respective current allocation relative to an optimal allocation at the same level of risk or at different points along the efficient risk-return spectrum. However, it is important to note that mean-variance analysis is purely a quantitative tool, which needs to be enhanced by considering appropriate and specific qualitative circumstances unique to these Funds.

The integration of both quantitative and qualitative factors in the design of a suitable strategic asset allocation is an essential and fundamental part of this process. As such, we used several investment constraints to avoid unreasonable allocations to asset classes that may be favored by the model on the basis of their attractive reward-to-risk and diversification properties. For example, the capital markets assumptions suggest that alternative investments offer great diversification opportunities and attractive risk-adjusted expected returns, which naturally cause the efficient frontier model to favor these asset classes over more traditional asset classes. In order to avoid this dynamic producing results that would seem unreasonable to stakeholders, we applied an investment constraint of a maximum of 15% to this segment due to the following reasons:

- Consideration of the illiquid nature of these asset classes (relative to traditional asset classes) and the potential liquidity requirements of the Fund X, in particular;
- Since the Fund X acts as a "buffer" mechanism, there may be instances when relatively large cash outflows may occur, particularly during declining economic conditions;
- Potential headline risk due to
 - Lack of transparency associated with some alternative asset classes;
 - Lack of regulation relative to other asset types; and,
 - Use of leverage.

As a reference point, we considered the exposure of other large national funds to alternative investments (including national pension funds for Australia, Norway, New Zealand, Ireland, some countries in the Middle East, and Japan). We found that some of these national funds have no exposure to alternative investments, while others maintain exposures as high as 20%-30% to various alternative asset classes. While we think alternative investments provide the potential to enhance investment diversification and risk-adjusted results over the long-term, we concluded it would not be prudent to consider allocating close to one-third of the Funds' assets in this specific segment, and adopted the constraint of 15% as a reasonably conservative limit.

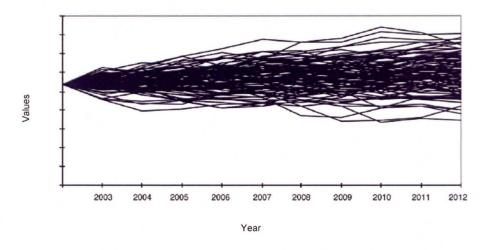
We believe the 15% maximum constraint represents an attractive mid-point in relation to the characteristics of other large national funds in other regions of the world while still providing for a healthy and meaningful exposure in this area to enhance the potential for expected returns and diversification benefits over the long-term.

In terms of the selection of the asset classes considered in the evaluation, we focused on a number of factors, including the permissible investments of both Funds (realizing that the Fund X has no explicit restrictions other than investing the assets outside of Country X, contrary to the Fund Y, which has the 25% restriction on the aggregate allocation to stocks and corporate bonds), the current broad asset allocation, and additional traditional and alternative asset classes that offered attractive risk-reward and diversification characteristics.

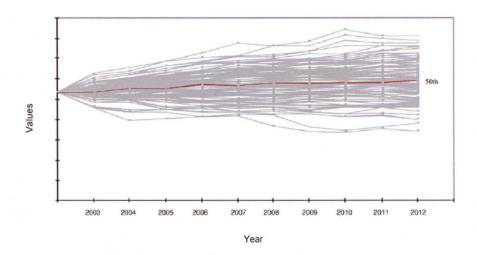
Stochastic Analysis

Once the candidate portfolios were identified using mean-variance analysis, we utilized stochastic modeling to include multiple risk factors and performed projections over a 10-year time horizon. The stochastic modeling process simulates the expected return of a portfolio considering various possible strategic asset allocations. To capture uncertainty, it is necessary to model the variability of changes in the key factors driving asset returns. This is allowed for by specifying standard deviations for the change in each factor governing the likely scale of fluctuations, and correlations, governing the interrelationships between changes in one factor and another. We therefore assigned values to the uncertainty in the key economic and asset class variables and the correlations between them.

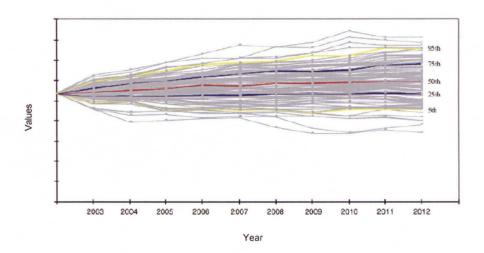
By generating a number of trials, a probability distribution or outcomes can be generated. For any one variable for 1000 trials over a ten-year period, this might look like the pattern in the following chart.



Each strategic asset allocation will produce a different range of outcomes, and we can then make objective comparisons between possible strategies. We can start by focusing on the median outcome, as illustrated on the chart below, for the variable in question (returns, cash flows, terminal fund values, or other asset or economic variable).



To evaluate the degree of uncertainty, we can then look at the distribution of results, for example the 250th best and the 750th outcomes (out of 1000), as being the lower and upper quartiles of the distribution. To give us a feel for best- and worst-case outcomes; we also analyze more extreme results. Typically, these are represented by the 5th and 95th percentiles. These results are illustrated on the chart below.



These stochastic projections provide a more realistic set of outcomes which consider a variety of asset class and economic variables when compared to the output from mean-variance analysis, and serve as an important component of the analysis in the design of a suitable investment strategy. The next section of this report summarizes the Monte-Carlo projections for the key portfolios we considered in the evaluation.

4

Mean Variance Analysis

Capital Markets Assumptions Liability Assumptions (Fund Y) Efficient Frontier Analysis

Mean Variance Analysis

Capital Markets Assumptions

Risk-Return Assumptions - Expected Long-Term Values

Asset Class	Absolute Return	Standard Deviation	
Global Equity	1	9.8%	17.5%
Global Government Bonds - Short/Intermediate	2	4.9%	3.0%
Global Government Bonds - Long	3	5.5%	8.0%
Global Corporate Bonds - Short/Intermediate	4	5.5%	3.2%
Global Corporate Bonds - Long	5	6.4%	8.2%
Global TIPS	6	5.2%	4.0%
Global Cash/Enhanced Cash	7	4.0%	1.3%
Global Private Equity	8	12.8%	28.4%
Global Real Estate	9	8.3%	15.0%
Global Infrastructure	10	9.9%	20.2%
Global Absolute Return/Opportunistic	11	7.0%	5.5%

The table above depicts the risk-return assumptions that were used to develop candidate portfolios based on mean variance analysis. The mean variance model seeks to identify the optimal combination of asset classes that provide the highest return for a given level of risk.

Below is the matrix of expected correlations illustrating the expected forward-looking relationships of returns between the various asset classes that the Fund Y and Fund X could potentially have exposure to.

Asset Class Correlation Assumptions – Expected Long Term Values

		1	2	3	4	5	6	7	8	9	10	11
Global Equity	1	1										
Global Government Bonds - Short/Intermediate	2	0.30	1									
Global Government Bonds - Long	3	0.35	0.95	1								
Global Corporate Bonds - Short/Intermediate	4	0.35	0.95	0.92	1							
Global Corporate Bonds - Long	5	0.40	0.90	0.95	0.95	1						
Global TIPS	6	0.20	0.50	0.40	0.50	0.40	1					
Global Cash/Enhanced Cash	7	0.00	0.25	0.10	0.25	0.10	0.40	1				
Global Private Equity	8	0.70	0.10	0.20	0.20	0.25	0.15	0.00	1			
Global Real Estate	9	0.50	0.15	0.20	0.20	0.25	0.20	0.00	0.50	1		
Global Infrastructure	10	0.55	0.15	0.20	0.20	0.25	0.20	0.00	0.50	0.23	1	
Global Absolute Return/Opportunistic	11	0.30	0.10	0.10	0.15	0.20	0.10	0.00	0.20	0.20	0.20	1

Liability Assumptions (Fund Y)

Risk-Return Assumptions - Expected Long-Term Values

We worked in conjunction with the Ministry of XXX to develop what we believe are plausible liability assumptions for Fund Y. Given the lack of long-dated bond data in the local Country X market, we had to use proxies in the process of developing what we believe are reasonable return, volatility and correlation assumptions – three essential factors needed in funded status optimization. We used a combination of forward-looking and historical data to support the final assumptions. The various factors we used in the methodology included:

A. Expected Arithmetic Return Assumption: 9.40%

- Cash Flow Data We received cash outflow projections from the Ministry of XXX extending to the year 2038. The 9.40% figure represents the expected arithmetic return on the liabilities (which is related to the 6.50% geometric discount rate explained in item number 3 below and which will vary depending on the expected standard deviation for the liabilities the higher the standard deviation, the larger the difference between the arithmetic and geometric expected returns).
- 2. Liability Growth Calculation We calculated the liability growth based on projected cash outflow data provided through 2038. In addition, we extended the liability growth projection for another 10 years, assuming a liability growth not exceeding 6% by 2048. This liability growth is subject to change based on interest rate levels over time, but appears to be an appropriate qualitative assumption and one that the Ministry of XXX believes might be appropriate.
- 3. Discount Rate and Duration Calculations This was calculated using the projected cash outflows through 2048. With these two components, we were able to calculate a discount rate of 6.5% and duration of 25.7 years.

B. Expected Volatility Assumption: 45.0%

- We used yield curve data supplied by the Ministry of XXX. We calculated historical returns over the last 4.75 years using the yield data received for 1- and 10-year maturity Country X bonds, assuming a duration of 1 year for the 1-year series and 10 years for the 10-year series, as the data supplied reflected zero coupon bonds.
- 2. Using regression analysis, we estimated a logarithmic equation to calculate the yields of 30-year bonds, assuming a normal yield curve, and using the historical yields supplied. Once the yields for a hypothetical 30-year bond were prepared, we estimated historical quarterly returns for 30-year bonds going back 4.75 years and assuming an estimated duration of 25.7 years, which we calculated using the estimated cash outflow projections through 2048.

3. To calculate what we think is a reasonable proxy for the expected standard deviation of the liabilities, we interpolated between the historical volatility of the 10-year and hypothetical 30-year return series.

C. Expected Correlation Assumptions: (please see table below)

1. In the absence of more reliable data to estimate the correlations for the liabilities, we used the historical behavior of the estimated 30-year bond returns over the last 4.75 years as a basis to develop the correlation assumptions. We have summarized the correlation assumptions below.

Liability Correlation Assumptions – Proxy for Expected Long Term Values (USD)

Asset Class Variables	Correlation Assumptions
Global Equity	0.00
Global Gov't. Bonds – S/I	-0.30
Global Gov't. Bonds – Long	-0.30
Global Corp. Bonds – S/I	-0.25
Global Corp. Bonds – Long	-0.25
Global Inflation Protected Bonds	-0.20
Global Cash/Enhanced Cash	-0.10
Global Private Equity	0.05
Global Real Estate	0.00
Global Infrastructure	-0.05
Global Absolute Return/Opportunistic	-0.15

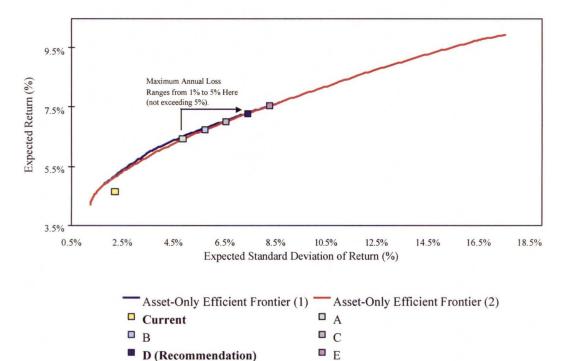
Despite the fact that careful consideration was given to the development of the liability assumptions presented above, we recommend considering this analysis as a strawman until more reliable data becomes available. We had to use a number of estimates to develop what we think are plausible return, volatility, and correlation assumptions for the Fund Y liabilities. The cash outflow projections provided by the Ministry of XXX for Fund Y may be subject to change due to future legislative initiatives or demographic changes that vary from the assumptions based on which these projections were developed.

We are confident in the portfolio recommendations, particularly considering the Fund Y will not experience any outflows until the year 2017, which supports a more aggressive stance relative to the Fund X. We recommend monitoring the evolution of the liabilities over time. We recommend the Ministry of XXX consider conducting an asset/liability study by the year 2014, at which point we expect more reliable data should be available to more accurately define the liabilities affecting the Fund . Doing this by the year 2014 should allow enough time to rebalance the portfolio to the new targets by the year 2017 or sooner.

Fund X

FUND X

Asset-Only Efficient Frontier



Asset-Only Efficient Frontier (1) - Constraints:

- Maximum allocation of 15% to alternative investments.
- Maximum allocation of 5% to private equity.
- Maximum allocation of 5% to real estate.
- Maximum allocation of 2% to infrastructure.
- Maximum allocation of 5% to absolute return/opportunistic strategies.

Asset-Only Efficient Frontier (2) - Constraints:

- Maintains the constraints to alternatives in Frontier 1.
- Includes a maximum constraint of 30% to short-intermediate corporate bonds. The unconstrained frontier (Frontier 1) designated what we believe to be unreasonable allocations to corporate bonds. Thus, a qualitative constraint was included to enhance diversification.

FUND X

Statistical Output

	Current	A	В	c	(Recommendation)	E
Global Equity	0%	10%	15%	20%	25%	30%
Gbl Gov't Bonds - Short/Intermediate	66%	0%	0%	0%	0%	0%
Gbl Gov't Bonds - Long	0%	0%	0%	0%	0%	0%
Gbl Corp Bonds - Short/Intermediate	0%	30%	30%	30%	30%	30%
Gbl Corp Bonds - Long	0%	6%	10%	13%	17%	20%
Gbl Inflation Indexed Bonds	4%	39%	30%	22%	13%	5%
Gbl Cash/Enhanced Cash	30%	0%	0%	0%	0%	0%
Gbl Private Equity	0%	4%	5%	5%	5%	5%
Gbl Real Estate	0%	4%	3%	3%	3%	3%
Gbl Infrastructure	0%	2%	2%	2%	2%	2%
GbI Absolute Return/Opportunistic	0%	5%	5%	5%	5%	5%
Expected Return (Arithmetic)	4.64%	6.42%	6.74%	7.01%	7.29%	7.55%
Expected Standard Deviation	2.20%	4.86%	5.75%	6.55%	7.42%	8.29%
Expected Return (Geometric)	4.62%	6.31%	6.59%	6.81%	7.03%	7.23%
Max Annual Loss @ 95% Confidence Interval	1.02%	-1.57%	-2.72%	-3.76%	-4.91%	-6.09%
Probability of Less Than 0% Return - One Year	1.79%	9.71%	12.60%	14.92%	17.16%	19.15%
Probability of Less Than 0% Return - Three Years	0.01%	1.23%	2.36%	3.59%	5.03%	6.54%
Probability of Less Than 0% Return - Five Years	0.00%	0.18%	0.52%	1.00%	1.70%	2.55%
Probability of Less Than 0% Return - Ten Years	0.00%	0.00%	0.01%	0.05%	0.14%	0.29%

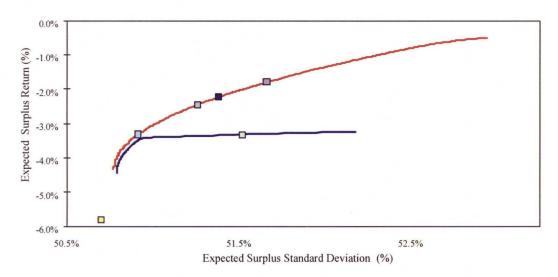
Observations

- Candidates A through D provide attractive expected returns and maintain the tolerable risk parameters expressed by the Ministry of XXX (not exceeding a maximum expected annual loss of 5% for Fund X at the 95% probability distribution confidence interval).
- Candidate E exhibits an increase of 5% to stocks and minor changes to long corporate bonds and inflation indexed bonds, which results in an expected maximum annual loss of 6.09%, which falls outside permissible parameters.

Fund Y

Fund Y

Asset/Liability Efficient Frontier



Asset/Liability Efficient Frontier (1) - Constraints/Maintains Current Policy:

- Maximum allocation of 25% to stocks and corporate bonds.
- Maximum allocation of 0% to cash/enhanced cash.
- Maximum allocation of 15% to alternative investments.
- Maximum allocation of 5% to private equity.
- Maximum allocation of 5% to real estate.
- Maximum allocation of 2% to infrastructure.
- Maximum allocation of 5% to absolute return/opportunistic strategies.

Asset/Liability Efficient Frontier (2) - Constraints/Relaxes Policy:

- No constraints to stocks or corporate bonds.
- Maximum allocation of 0% to cash/enhanced cash.
- Maximum allocation of 15% to alternative investments.
- Maximum allocation of 5% to private equity.
- Maximum allocation of 5% to real estate.
- Maximum allocation of 2% to infrastructure.
- Maximum allocation of 5% to absolute return/opportunistic strategies.

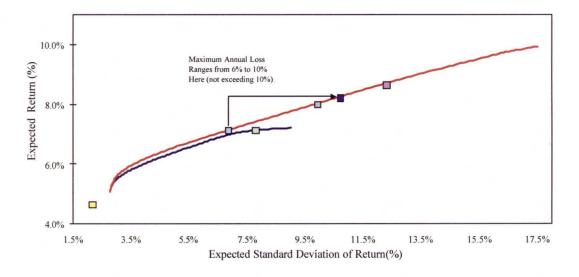
Fund Y
Statistical Output

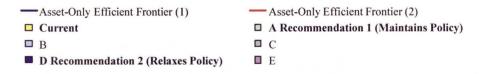
		Recommendation 1		Recommendation 2			
	Current	(Maintains Policy)	В	C	(Relaxes Policy)	E	
Global Equity	0%	25%	25%	45%	50%	60%	
Gbl Gov't Bonds - Short/Intermediate	66%	0%	0%	0%	0%	0%	
Gbl Gov't Bonds - Long	0%	30%	0%	0%	0%	0%	
Gbl Corp Bonds - Short/Intermediate	0%	0%	60%	40%	35%	25%	
Gbl Corp Bonds - Long	0%	0%	0%	0%	0%	0%	
3bl Inflation Indexed Bonds	3%	30%	0%	0%	0%	0%	
Gbl Cash/Enhanced Cash	31%	0%	0%	0%	0%	0%	
Sbl Private Equity	0%	5%	5%	5%	5%	5%	
Gbl Real Estate	0%	5%	5%	5%	5%	5%	
Gbl Infrastructure	0%	2%	0%	0%	0%	0%	
Gbl Absolute Return/Opportunistic	0%	3%	5%	5%	5%	5%	
Expected Surplus Return (Arithmetic)	-5.81%	-3.32%	-3.32%	-2.45%	-2.23%	-1.80%	
Surplus Standard Deviation (Tracking Error)	50.70%	51.52%	50.91%	51.26%	51.38%	51.66%	
Expected Surplus Return (Geometric)	-17.07%	-14.68%	-14.46%	-13.65%	-13.45%	-13.09%	

Observations

- These results were developed in funded status optimization, which takes into account the projected liabilities for this program through 20XX in USD.
- Portfolio A maintains current investment guidelines and provides exposure to long government bonds as well as inflation indexed bonds and alternative investments. The expected surplus return of this portfolio (or the difference in the expected return of the portfolio and the expected return of the liabilities) is in negative territory by 3.32% in arithmetic terms. By contrast, the current mix shows a negative surplus return of 5.81%.
- Based on the assumptions for the asset classes considered in the analysis and the proxies used to estimate the projected liabilities, these results may be indicative of the need to adopt a more aggressive asset allocation strategy in light of the projected liabilities, which will start affecting this program by 20XX.
- Recommendation 2 exhibits better results relative to the liabilities and a more aggressive stance. Given the expected liabilities of Fund Y and the decision not to withdraw assets until 20XX, we believe portfolio D provides the most attractive potential for return generation over the long term without violating the stated risk parameters while considering the compounding effect of returns over time and the ability to withstand short-term volatility in a 10-year investment horizon.

Fund Y
Asset-Only Efficient Frontier





Asset-Only Efficient Frontier (1) - Constraints/Maintains Policy:

- Maximum allocation of 25% to stocks and corporate bonds.
- Maximum allocation of 0% to cash/enhanced cash.
- Maximum allocation of 15% to alternative investments.
- Maximum allocation of 5% to private equity.
- Maximum allocation of 5% to real estate.
- Maximum allocation of 2% to infrastructure.
- Maximum allocation of 5% to absolute return/opportunistic strategies.

Asset-Only Efficient Frontier (2) - Constraints/Relaxes Policy:

- No constraints to stocks or corporate bonds.
- Maximum allocation of 0% to cash/enhanced cash.
- Maximum allocation of 15% to alternative investments.
- Maximum allocation of 5% to private equity.
- Maximum allocation of 5% to real estate.
- Maximum allocation of 2% to infrastructure.
- Maximum allocation of 5% to absolute return/opportunistic strategies.

Fund Y
Statistical Output

	Current	Recommendation 1 (Maintains Policy)	В	С	Recommendation 2 (Relaxes Policy)	E
Global Equity	0%	25%	25%	45%	50%	60%
Gbl Gov't Bonds - Short/Intermediate	66%	0%	0%	0%	0%	0%
Gbl Gov't Bonds - Long	0%	30%	0%	0%	0%	0%
Sbl Corp Bonds - Short/Intermediate	0%	0%	60%	40%	35%	25%
Gbl Corp Bonds - Long	0%	0%	0%	0%	0%	0%
Gbl Inflation Indexed Bonds	3%	30%	0%	0%	0%	0%
Gbl Cash/Enhanced Cash	31%	0%	0%	0%	0%	0%
Gbl Private Equity	0%	5%	5%	5%	5%	5%
Gbl Real Estate	0%	5%	5%	5%	5%	5%
Gbl Infrastructure	0%	2%	0%	0%	0%	0%
Gbl Absolute Return/Opportunistic	0%	3%	5%	5%	5%	5%
Expected Return (Arithmetic)	4.63%	7.12%	7.13%	8.00%	8.21%	8.65%
Expected Standard Deviation	2.18%	7.80%	6.87%	9.94%	10.73%	12.33%
Expected Return (Geometric)	4.61%	6.84%	6.91%	7.54%	7.68%	7.95%
Max Annual Loss @ 95% Confidence Interval	1.04%	-5.71%	-4.17%	-8.35%	-9.44%	-11.63%
Probability of Less Than 0% Return - One Year	1.55%	18.68%	15.39%	22.10%	23.42%	25.68%
Probability of Less Than 0% Return - Three Years	0.01%	6.16%	3.87%	9.15%	10.45%	12.89%
Probability of Less Than 0% Return - Five Years	0.00%	2.33%	1.13%	4.28%	5.24%	7.20%
Probability of Less Than 0% Return - Ten Years	0.00%	0.24%	0.06%	0.75%	1.09%	1.94%

Observations

- Candidates A through D provide attractive expected returns and maintain the tolerable risk parameters expressed by the Ministry of XXX (not exceeding a maximum expected annual loss of 10% for Fund Y at the 95% probability distribution confidence interval).
- Candidate A, the recommendation considering current investment guidelines, allocates 25% to stocks, 60% to fixed income, and 15% to alternative investments. This portfolio yields a maximum annual loss of 5.71% at the 95th percentile.
- Candidates B and C provide a higher exposure to stocks and a meaningful exposure to corporate bonds, while maintaining the limits to alternative investments.
- Candidate D, the recommendation considering the amendment of current investment guidelines, exhibits a higher allocation to stocks and a modest allocation to corporate bonds (in relation to Recommendation 1).
- Candidate E exhibits an increase of 10% to stocks and a commensurate decrease to corporate bonds, which results in an expected maximum annual loss of 11.63% at the 95th percentile, falling outside permissible parameters.

5

Stochastic Analysis – Detailed Fund Evaluation

Fund X

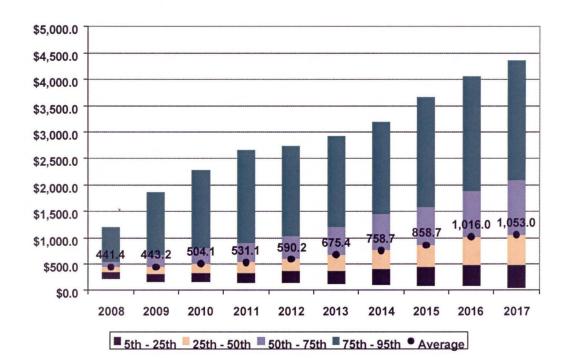
Fund Y

Fund X

Asset Allocation and Summary Statistical Output

		Orest	No.	./	•/	6/	Strander	•/
	Global Equity	0%	10%	15%	20%	25%	30%	
	Global Fixed Income - Gov - Short/Intermd	66%	0%	0%	0%	0%	0%	
_	Global Fixed Income - Gov - Long	0%	0%	0%	0%	0%	0%	
ţi	Global Fixed Income - Corp Short/Intermd	0%	30%	30%	30%	30%	30%	
Asset Allocation	Global Fixed Income - Corp Long	0%	6%	10%	13%	17%	20%	
¥	Global TIPS	4%	39%	30%	22%	13%	5%	
t	Global Cash	30%	0%	0%	0%	0%	0%	
SS	Global Private Equities	0%	4%	5%	5%	5%	5%	
4	Global Real Estate	0%	4%	3%	3%	3%	3%	
	Global Infrastruture	0%	2% 5%	2% 5%	2% 5%	2% 5%	2% 5%	
	Global Absolute Return/Opportunistic							
	Correlation (Nominal Portfolio Returns; Nominal GDP Growth)	0.05	0.14 0.07	0.13	0.13	0.12	0.12 0.09	
	Correlation (Nominal Portfolio Returns; Real GDP Growth) Correlation (Nominal Portfolio Returns; Nominal Price)	-0.03	0.07	0.00	0.08	0.09	0.03	
	Correlation (Real Portfolio Returns; Nominal Price)	-0.05	0.19	0.20	0.21	0.23	0.23	
	Portfolio Expected Nominal Returns (USD)	4.70%	6.12%	6.35%	6.55%	6.78%	6.98%	
S	Portfolio Nominal Returns Volatility (USD)	2.16%	4.67%	5.39%	6.23%	7.16%	8.06%	
Statistics	Lowest Annual Return Observed from 2008 to 2017 (95th Percentile)	1.00%	-1.50%	-2.33%	-3.30%	-4.48%	-5.74%	
tat	Change in Nominal Return From Current Allocation		1.43%	1.66%	1.85%	2.08%	2.28%	
S	Change in Nominal Risk From Current Allocation		2.51%	3.23%	4.07%	5.00%	5.90%	
	Portfolio Expected Nominal Returns	5.98%	7.44%	7.69%	7.94%	8.12%	8.33%	
	Portfolio Nominal Returns Volatility	12.24%	13.11%	13.40%	13.85%	14.30%	14.81%	
	Duration	1.35	1.71	1.79	1.83	1.91	1.94	
	Liquidity Ratio	9.90	8.01	7.96	7.91	7.86	7.82	

Current Portfolio Total Cash Outflow Projections

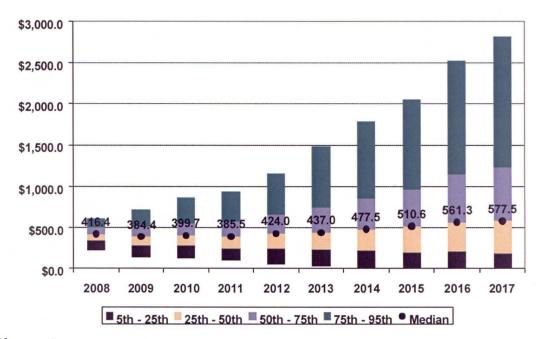


FUND X - Total Withdrawals in USD millions (Current Portfolio)

- The exhibit above shows the expected level of outflows (withdrawals) that are possible from the Fund X. Since all the returns from the Fund X Fund will be used as a source of revenue for the fiscal program, the median withdrawal level as a percentage of the Fund's assets will be highly related to the mean expected returns.
- The extreme values observed in each year in the chart represent the higher or lower levels of outflows from the Fund. In this case, the worst-case scenarios can be a result of weak GDP growth, a decline in the commodity price and poor investment results. All these factors may induce a higher withdrawal from the Fund.
- The worst-case scenario (5th percentile) is represented by the green part of the bars on the chart. The best-case scenario (95th percentile), on the other hand, can be a result of strong GDP growth, rising the commodity prices and attractive investment returns. All these factors may induce a lower withdrawal from the Fund. This set of factors is represented by the grey part of the bars in the chart.

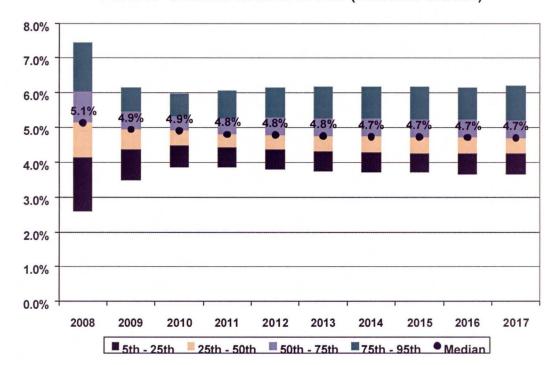
Current Portfolio Return Withdrawals

FUND X - Return Withdrawals in USD millions (Current Portfolio)



- The exhibit above shows the expected level of outflows from return.
- These asset values are primarily driven by the return potential of the portfolio. Therefore, these values will be higher for riskier portfolios exhibiting higher return potential.
- Since the current portfolio exhibits the lowest return potential of all the portfolios
 presented in this report, it will also provide the lowest expected outflow if everything
 else is held constant.

Current Portfolio Return Projections



FUND X - Nominal Returns in USD (Current Portfolio)

- The distribution of returns shown above consists of annualized or geometric average results of prior years.
- The assumption about the nominal annualized return of the current portfolio is based on the 4.7% annualized median return over the 10-year period. Considering that currently the Fund X and Fund Y Funds' asset allocation is identical, the results for the nominal returns in both cases are also very similar.

Fund Y
Statistical Output

	Current	Recommendation 1 (Maintains Policy)	В	С	Recommendation 2 (Relaxes Policy)	E
Global Equity	0%	25%	25%	45%	50%	60%
Sbl Gov't Bonds - Short/Intermediate	66%	0%	0%	0%	0%	0%
Gbl Gov't Bonds - Long	0%	30%	0%	0%	0%	0%
bl Corp Bonds - Short/Intermediate	0%	0%	60%	40%	35%	25%
bl Corp Bonds - Long	0%	0%	0%	0%	0%	0%
Sbl Inflation Indexed Bonds	3%	30%	0%	0%	0%	0%
6bl Cash/Enhanced Cash	31%	0%	0%	0%	0%	0%
6bl Private Equity	0%	5%	5%	5%	5%	5%
bl Real Estate	0%	5%	5%	5%	5%	5%
Sbl Infrastructure	0%	2%	0%	0%	0%	0%
6bl Absolute Return/Opportunistic	0%	3%	5%	5%	5%	5%
xpected Return (Arithmetic)	4.63%	7.12%	7.13%	8.00%	8.21%	8.65%
xpected Standard Deviation	2.18%	7.80%	6.87%	9.94%	10.73%	12.33%
xpected Return (Geometric)	4.61%	6.84%	6.91%	7.54%	7.68%	7.95%
Max Annual Loss @ 95% Confidence Interval	1.04%	-5.71%	-4.17%	-8.35%	-9.44%	-11.63%
Probability of Less Than 0% Return - One Year	1.55%	18.68%	15.39%	22.10%	23.42%	25.68%
Probability of Less Than 0% Return - Three Years	0.01%	6.16%	3.87%	9.15%	10.45%	12.89%
Probability of Less Than 0% Return - Five Years	0.00%	2.33%	1.13%	4.28%	5.24%	7.20%
Probability of Less Than 0% Return - Ten Years	0.00%	0.24%	0.06%	0.75%	1.09%	1.94%

- Candidates A through D provide attractive expected returns and maintain the tolerable risk parameters expressed by the Ministry of XXX (not exceeding a maximum expected annual loss of 10% for Fund at the 95% probability distribution confidence interval).
- Candidate A, the recommendation considering current investment guidelines, allocates 25% to stocks, 60% to fixed income, and 15% to alternative investments. This portfolio yields a maximum annual loss of 5.71% at the 95th percentile.
- Candidates B and C provide a higher exposure to stocks and a meaningful exposure to corporate bonds, while maintaining the limits to alternative investments.
- Candidate D, the recommendation considering the amendment of current investment guidelines, exhibits a higher allocation to stocks and a modest allocation to corporate bonds (in relation to Recommendation 1).
- Candidate E exhibits an increase of 10% to stocks and a commensurate decrease to corporate bonds, which results in an expected maximum annual loss of 11.63% at the 95th percentile, falling outside permissible parameters.

Portfolio D (Recommendation) Total Cash Outflow Projections

\$7,000.0 \$6,000.0 \$5,000.0 \$4,000.0 \$3,000.0 965.5 1,025.0 1,094.2 1,230.9 1,343.2 ^{1,522.5} \$2,000.0 841.6 \$1,000.0 \$0.0 2017 2008 2009 2010 2011 2012 2013 2014 2015 2016 ■ 5th - 25th ■ 25th - 50th ■ 50th - 75th ■ 75th - 95th ● Average

FUND X - Total Withdrawals in USD (Portfolio D - Recommendation)

- The chart above presents the expected withdrawals from the Fund. Since all the returns generated by the Fund will be withdrawn each year, we see a close relationship between the expected return and withdrawal rate for each year.
- In comparison to the current portfolio's results, we have higher expected withdrawal (due to the higher expected returns for Portfolio D).
- The "worst" cases (the ones that require higher withdrawal levels and are represented by the green portion of the bars) (95th percentile) indicate a withdrawal of \$6.2 billion.
- Since the expected investment return for Portfolio D is higher than the current portfolio, we would expect a lower portion of the principal value of the Fund to be withdrawn on any one-year period in the case of Portfolio D if there is a need to withdraw the principal during times of weak GDP growth and falling commodity prices.
- The "best" case scenario (5th percentile) is represented by the grey bars in the chart above, signifying lower levels of withdrawals.

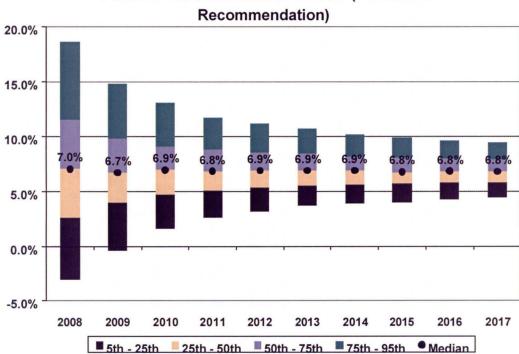
Portfolio D (Recommendation) Return Withdrawals

\$7,000.0 \$6,000.0 \$5,000.0 \$4,000.0 \$3,000.0 \$2,000.0 \$1,000.0 593.9 536.0 561.9 \$0.0 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 ■ 5th - 25th ■ 25th - 50th ■ 50th - 75th ■ 75th - 95th ● Median

FUND X - Return Withdrawals in USD (Portfolio D - Recommendation)

- The exhibit above shows the expected level of outflows from return.
- Since these values are driven by the return potential of the portfolio, their expected values are higher for Portfolio D than the current portfolio.

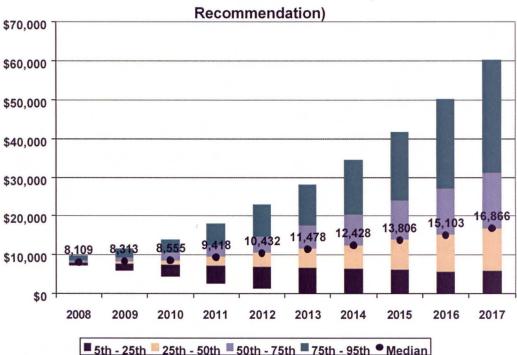
Portfolio D (Recommendation) Return Projections



FUND X - Nominal Returns in USD (Portfolio D -

- The chart above depicts the nominal return for the portfolio over the next ten years. The two most relevant observations are: the expected median return and the worst case (5th percentile) expected return for the ten year period (lowest portion of the grey bars).
- The expected return of Portfolio D is 6.8%. The current portfolio provides an expected return of 4.7% (2.1% below the expected return for Portfolio D).
- The worst-case (5th percentile) expected return for Portfolio D is 4.5%, which is 0.8% higher than the current portfolio.
- The best-case (95th percentile) expected return for Portfolio D is 9.5%, which is 3.3% higher than the current portfolio's projected return.

Portfolio D (Recommendation) Terminal Value Projections



FUND X - Nominal Value in USD millions (Portfolio D -

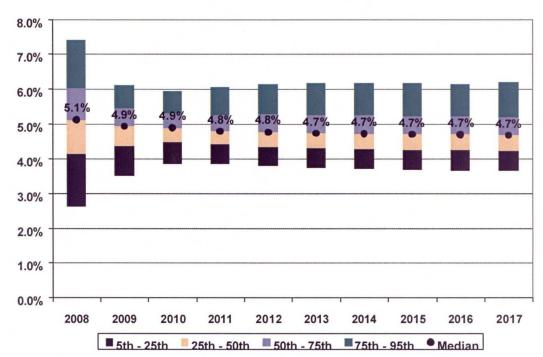
- The chart above shows the median terminal value of \$16.9 billion for Portfolio D at the end of 2017. The current policy, which allows the withdrawal of the investment returns of this Fund, limits its growth potential over time.
- However, if the current policy is maintained (the withdrawal of investment returns out of the Fund), Portfolio D should provide a larger contribution to cover fiscal spending, allowing the Ministry to withdraw larger amounts of assets mainly as a function of realizing higher investment returns over time.
- If the Ministry were to adopt a more conservative withdrawal policy, this Fund should be able to generate a higher terminal value than the current portfolio at the expense of providing less coverage of fiscal spending than under the current withdrawal policy.
- In the best-case scenario (95th percentile), represented by the highest portion of the green bar in the chart above, the terminal value of this portfolio (year 2017) is \$60.4 billion.
- In the worst-case (5th percentile) scenario (lowest portion of the grey bar) the value is expected to be \$0.0 billion.

Fund Y

Asset Allocation and Summary Statistical Output

			Det Recording	And the Control of th	· /	C ORBOTA	add to the last	·/
_	lour de la	-				De 54	2001	
1	Global Equity	0%	25%	25%	45%	50%	60%	
1_	Global Fixed Income - Gov - Short/Intermd	66%	0%	0%	0%	0%	0%	
Ö	Global Fixed Income - Gov - Long Global Fixed Income - Corp Short/Intermd	0% 0%	30% 0%	0% 60%	0% 40%	0% 35%	0% 25%	
ocation	Global Fixed Income - Corp Shorvintering	0%	0%	0%	0%	0%	0%	
A S	Global TIPS	3%	30%	0%	0%	0%	0%	
et A	Global Cash	31%	0%	0%	0%	0%	0%	
sse	Global Private Equities	0%	5%	5%	5%	5%	5%	
As	Global Real Estate	0%	5%	5%	5%	5%	5%	
	Global Infrastruture	0%	2%	0%	0%	0%	0%	
1	Global Absolute Return/Opportunistic	0%	3%	5%	5%	5%	5%	
	Correlation (Nominal Portforlio Returns; Nominal GDP Growth)	0.05	0.13	0.12	0.13	0.13	0.13	
1	Correlation (Nominal Portfolio Returns; Real GDP Growth)	-0.03	0.09	0.10	0.10	0.10	0.10	
1	Correlation (Nominal Portfolio Return; Nominal Price)	-0.03	0.22	0.23	0.26	0.27	0.28	
1	Correlation (Real Portfolio Return; Nominal Price)	-0.05	0.22	0.22	0.26	0.26	0.27	
1 00	Portfolio Expected Nominal Returns (USD)	4.69%	6.80%	6.76%	7.39%	7.55%	7.80%	
Statistics	Portfolio Nominal Returns Volatility (USD)	2.14%	7.70%	6.83%	9.87%	10.67%	12.30%	
l ÷	Lowest Annual Return Observed from 2008 to 2017 (95th Percentile)	1.01%	-5.37%	-4.10%	-7.97%	-8.97%	-11.15%	
Sta	Change in Nominal Return From Current Allocation		2.12%	2.08%	2.71%	2.86%	3.11%	
1	Change in Nominal Risk From Current Allocation		5.56%	4.69%	7.73%	8.53%	10.16%	
1	Portfolio Expected Nominal Returns	5.97%	8.17%	8.08%	8.80%	8.92%	9.14%	
1	Portfolio Nominal Returns Volatility	12.23%	14.61%	14.19%	16.07%	16.59%	17.78%	
	Duration	1.34	2.55	1.08	0.72	0.63	0.45	
	Liquidity Ratio	9.90	8.26	7,78	7.88	7.90	7.95	Į.

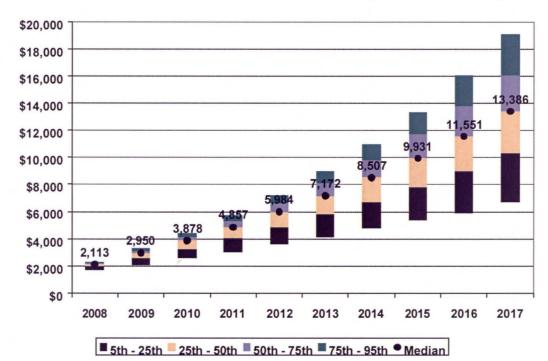
Current Portfolio Return Projections



Fund Y - Nominal Returns in USD (Current Portfolio)

- The chart above depicts the nominal return of the portfolio over the next ten years. The distribution of returns shown here are geometric average results of prior years.
- Under the worst-case, which is defined as a 5th percentile event in this report, we would expect this portfolio to generate an annualized return of 3.6%, in nominal terms, for the next ten years.
- The best-case scenario, 95th percentile, is a return of 6.2%, represented by the grey portion of the return distribution for the year 2017.

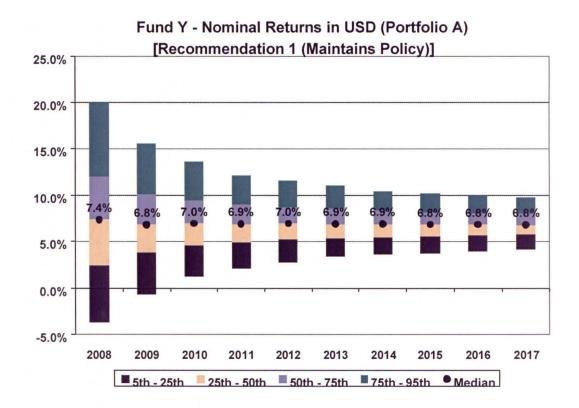
Current Portfolio **Terminal Value Projections**



Fund Y - Nominal Value in USD millions (Current Portfolio)

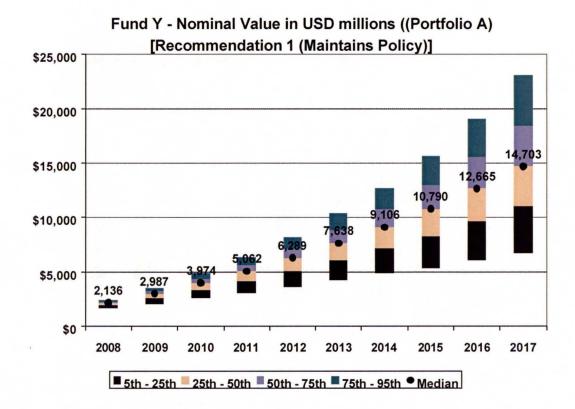
- At the end of year 2017 we expect the value of the Fund to reach \$13.4 billion, based on the median value of the stochastic results.
- The results already take into account a guaranteed inflow of 0.2% of GDP into the Fund every year, consistent with current policy. The model assumes that the real GDP of Country X will grow approximately 5% year-over-year, bolstering the asset size with continuously increasing cash inflows into the Fund every year.
- The worst-case scenario (5th percentile) would be an asset value of \$6.7 billion, illustrated by the lowest point of the grey bar for the year 2017. The likelihood of that happening is approximately 5%.
- On the other hand, the best-case value this fund can reach (at the 95th percentile) is \$19.1 billion and the likelihood of that happening is also 5%.

Portfolio A (Recommendation 1) **Return Projections**



- The returns of this portfolio will be slightly higher than the current portfolio, as shown by the chart above. The median annualized ten-year return of the Fund Y Fund may increase by 2.1% if the asset allocation were moved to Portfolio A.
- Under the worst-case scenario (5th percentile), Portfolio A is expected to generate 0.6% higher ten-year annualized return than the current portfolio.
- The best-case scenario (95th percentile) for Portfolio A is a return of 9.8%, an increase of 3.5% relative to the return projected for the current portfolio.
- We believe taking on the additional risk on the Fund Y Fund to realize higher potential return is in-line with the goal of maximizing the value of this Fund given that it does not have any outflows for the next ten years.

Portfolio A (Recommendation 1) Terminal Value Projections



- The chart above shows the median terminal value of \$14.7 billion for Portfolio A at the end of 2017, which is an increase of \$1.3 billion from the current portfolio.
- Under the worst-case (5th percentile) scenario, represented by the lowest portion of the grey bars in the chart above, the terminal value of this portfolio (year 2017) will be \$74 million higher if the current portfolio's asset allocation were changed to Portfolio A.
- Portfolio A can potentially achieve a terminal value of \$23.1 billion, under the bestcase (95th percentile) scenario, resulting in a \$4.0 billion increase in terminal value relative to the current portfolio.
- Therefore, we recommend adopting Portfolio A as the Fund's asset allocation if the Ministry decides to maintain its current restriction of no more than 25% allocation to Global Equity and Corporate Bonds.

Portfolio D (Recommendation 2) **Return Projections**

[Recommendation 2 (Relaxes Policy)] 30.0% 25.0% 20.0% 15.0% 10.0% 5.0% 0.0% -5.0% -10.0% 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 ■ 5th - 25th 25th - 50th 50th - 75th ■ 75th - 95th

Fund Y - Nominal Returns in USD (Portfolio D)
[Recommendation 2 (Relaxes Policy)]

- We expect the annualized return of Portfolio D to reach 7.6% for the ten year projected period shown in the chart above, which is an increase of 2.9% from the current allocation.
- Even under the worst-case (5th percentile) scenario we expect to see a 0.2% increase in annualized returns for the ten-year period from Portfolio D relative to the current portfolio.
- Under the best-case (95th percentile) scenario, Portfolio D is projected to achieve a return of 11.9%, an increase in return of 5.7% relative to the current portfolio.
- Given that this portfolio has no outflow over the next ten years, we believe adopting Portfolio D's higher risk asset allocation to maximize the value of the Fund Y Fund is prudent.

Portfolio D (Recommendation 2) **Terminal Value Projections**

[Recommendation 2 (Relaxes Policy)] \$30,000 \$25,000 \$20,000 15,317 \$15,000 13,098 \$10,000 \$5,000 \$0 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 ■ 5th - 25th ■ 25th - 50th ■ 50th - 75th ■ 75th - 95th ● Median

Fund Y - Nominal Value in USD millions (Portfolio D)
[Recommendation 2 (Relaxes Policy)]

- Portfolio D's asset value projection at the end of year 2017 is expected to be \$15.3 billion, as shown by the chart above. By moving the asset allocation from where it is now to that of Portfolio D, the Fund is expected to increase in value by \$1.9 billion at the end of year 2017.
- Under the worst-case (5th percentile) scenario, Portfolio D may be able to achieve a market value of \$6.7 billion, an increase of approximately \$60 million from the projection for the current portfolio.
- If the Fund Y were to adopt Portfolio D's asset allocation, it is expected to achieve a terminal value of \$25.5 billion, under the best-case (95th percentile) scenario, compared to a value of \$19.1 billion for the current portfolio.

6

Quantitative Analysis

Summary Monte-Carlo Simulation Results – All Variables
Five-Year Historical Results – Representative Market Indices
Fifteen-Year Historical Results – Representative Market Indices

Quantitative Analysis

Summary Monte-Carlo Simulation Results - Individual Variables

The medians in the actual Monte-Carlo simulations were as follows:

Variables	Absolute Return	Standard Deviation
Global Equity	9.6%	17.1%
Global Government Bonds - Short/Intermediate	4.7%	3.0%
Global Government Bonds - Long	5.2%	6.5%
Global Corporate Bonds - Short/Intermediate	5.1%	3.1%
Global Corporate Bonds - Long	5.7%	6.6%
Global TIPS	5.0%	3.7%
Global Cash/Enhanced Cash	4.0%	0.9%
Global Private Equity	12.2%	22.9%
Global Real Estate	8.0%	11.3%
Global Infrastructure	9.7%	17.0%
Global Absolute Return/ Opportunistic	7.0%	5.2%
U.S. Inflation	2.5%	1.2%
U.S. Nominal 10-Year	5.0%	0.8%
FX	1.8%	11.5%
Inflation	3.1%	1.3%
Nominal GDP Growth	8.2%	3.0%
Nominal 10-Year	6.5%	1.1%
ROR - U.S. Dollar	7.3%	26.2%
ROR -	8.8%	29.2%

The highlighted portion of the correlation matrix below shows that Mercer expects all of the recommended asset classes will have little to no correlation to the Country X Government's sources of revenue, i.e. local GDP growth and the commodity price. Therefore, adopting a set of investment strategies from these asset classes should help the Ministry of XXX reduce the cyclicality of Government expenditures.

Median Correlations - Ten-Year Results (forward looking)

Five-Year Historical Results – Representative Market Indices

Risk-Return Results (as of June 30, 20XX)

	Equity	Intermediate	Long	Intermediate	Long	TIPS	Estate	Price	Growth
100 m	MSCI AC	Lehman Global Government 1	Lehman Global -Government	Lehman Global Corporate 1-	Lehman Global Corporate	Global Inflation Linked	FTSE Global ERPA/NA REIT	Dow Jones	
	World	3 Years	3+ Years	3 Years	3+Years	Bond	Index	Index	GDP
1 Year - Return	16.42%	5.13%	5.37%	5.43%	5.88%	4.02%	32.66%	36.67%	5.84%
3 Year - Return	15.97%	3.22%	4.24%	3.37%	3.85%	4.07%	28.47%	43.83%	5.70%
5 Year - Return	11.68%	3.44%	5.42%	4.04%	6.16%	6.80%	27.00%	38.59%	5.00%
10 Year - Return	8.37%	N/A	N/A	N/A	N/A	N/A	13.67%	14.05%	4.01%
15 Year - Return	9.93%	N/A	N/A	N/A	N/A	N/A	14.57%	13.86%	5.06%
5 Year - Risk	16.19%	1.14%	3.69%	1.24%	3.98%	4.07%	15.10%	29.79%	6.01%
5 Year - Reward to Risk	0.72	3.03	1.47	3.25	1.55	1.67	1.79	1.30	0.83

Historical results vary depending on the time-period observed, which is driven by what part of the economic cycle that specific time period covers. For example, if we were to look at the five-year results, the time period which has data for all the indices presented, the equity returns are stronger than Mercer's assumptions while the fixed income results are weaker. This is primarily driven by the fact that this period covers the recovery part of the economic cycle when we would expect this type of result. However, we believe the assumptions should lie close to the midpoint of the uncertain distribution of actual outcomes for the return and risk characteristics of each asset class over the long-run in the future.

Trailing Correlation Analysis (as of June 30, 20XX)*

		1	2	3	4	5	6	7	8	9
MSCI AC World	1	1								
Lehman Global Government 1-3 Years	2	-0.46	1							
Lehman Global Government 3+ Years	3	-0.42	0.84	1						
Lehman Global Corporate 1-3 Years	4	-0.24	0.90	0.81	1					
Lehman Global Corporate 3+ Years	5	-0.12	0.73	0.90	0.88	1				
Global Inflation Linked Bond	6	-0.37	0.70	0.91	0.72	0.85	1			
FTSE Global ERPA/NAREIT Index	7	0.75	-0.04	-0.06	0.10	0.16	0.02	1		
Dow Jones Index	8	0.28	-0.18	-0.27	-0.16	-0.19	-0.11	0.26	1	
GDP	9	0.40	-0.22	-0.22	-0.20	-0.14	-0.27	0.24	0.05	

^{*}Calculated based on quarterly data.

The five-year correlation matrix shown above is also reflective of the time period of the analysis and corresponding market conditions. One example of this is the strong negative correlation between fixed income and equity, highlighted in blue. This is to be expected from this portion of the economic cycle since yields of fixed income securities have risen over this period leading to a decline in the price of bonds while strong GDP growth has propelled equity prices.

We provide longer-term historical returns, risk, and correlation analysis on the following page. This analysis covers a period of 15 years and includes representative asset classes, consistent with the broad asset classes considered in the model.

Fifteen-Year Historical Results – Representative Market Indices

Risk-Return Results (as of June 30, 20XX)

	Global Equity	Global Government Bond	Cash/Enhanced Cash Index	Cash/Enhanced Cash Index	Global Real Estate	Price	GDP Growth
	MSCI AC World	Global Government Bond	Citrigroup U.S. 3-Month T-Bill	LIBOR 3-Month	FTSE Global ERPA/NAREIT Index	Dow Jones Index	GDP Growth
1 Year - Return	16.42%	6.60%	4.98%	5.33%	32.66%	36.67%	5.84%
3 Year - Return	15.97%	1.79%	3.33%	3.74%	28.47%	43.83%	5.70%
5 Year - Return	11.68%	7.40%	2.51%	2.81%	27.00%	38.59%	5.00%
10 Year - Return	8.37%	5.48%	3.67%	4.03%	13.67%	14.05%	4.01%
15 Year - Return	9.93%	6.46%	3.92%	4.27%	14.57%	13.86%	5.06%
15 Year - Risk	14.86%	6.66%	0.79%	0.84%	16.33%	25.83%	6.31%
15 Year - Reward to Risk Ratio	0.67	0.97	4.97	5.09	0.89	0.54	0.80

Trailing Correlation Analysis (as of June 30, 20XX)*

			Global	Cash/Enhan	Cash/Enhan		100	
		Global Equity	Government Bond	ced Cash Index	ced Cash Index	Global Real Estate	Price	GDP Growth
		1	2	3	4	5	6	7
MSCI AC World	1	1						
Merrill Lynch Global Government Bond	2	-0.08	1					
Citrigroup U.S. 3-Month T-Bill	3	-0.07	-0.10	1				
LIBOR 3-Month	4	-0.04	-0.09	0.99	1			
FTSE Global ERPA/NAREIT Index	5	0.60	0.05	-0.18	-0.18	1		
Dow Jones Index	6	0.15	-0.09	-0.15	-0.12	0.23	1	
GDP Growth	7	0.32	0.00	0.03	0.04	0.14	0.08	1

^{*}Calculated based on quarterly data as of March 31, 20XX

7

Testing

Back Testing

Deterministic Economic Scenarios – Favorable and Unfavorable Environments

Sensitivity Analysis – Varying Correlation Analysis for the Commodity Price, Country X GDP Growth, and Global Equity

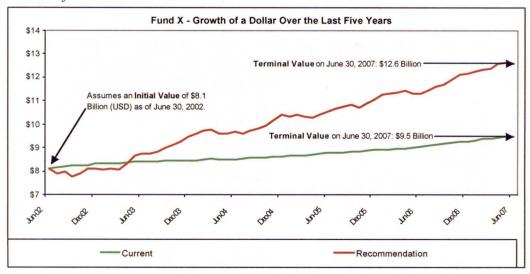
Testing

Back Testing

Summary 5-Year Results - Returns and Standard Deviation

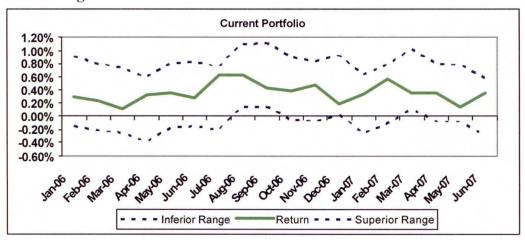
FUND X

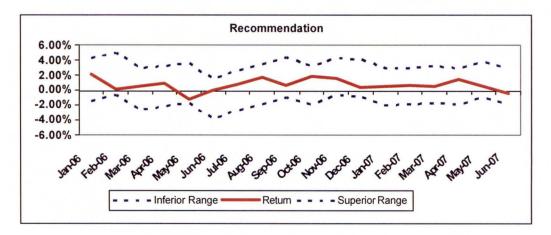
Growth of a Dollar - 2002 to 2007



- This analysis represents the growth of assets over five years based on the historical returns of representative indices for each of the portfolios. It assumes an initial value of \$8.1 billion (USD) as of June 30, 2002, and no contributions or distributions.
- The recommended mix for this Fund yielded an excess of \$3.1 billion relative to the Current portfolio over the last five years.
- While we do not believe historical performance is a good indication of future results, this analysis helps illustrate the opportunity set afforded by the recommendations.

Back-Testing





- This analysis includes a statistical representation of the portfolio's range of possible investment returns, assuming a normal distribution of returns. This analysis can be completed in many different ways, but for purposes of the illustration above, we used monthly return data and rolling five-year standard deviations. While these exhibits show a range of returns of one and one-half years, we actually covered a period of five years to calculate the rolling five-year standard deviations.
- The red line represents monthly returns ranging from January 2006 to June 2007. The dotted blue lines above and below the red line exhibit rolling 5-year standard deviation of returns over the prior month (also calculated using monthly frequency), which represent two standard deviations away from the mean and theoretically accounts for approximately 95% of possible return outcomes.
- If a return falls outside the dotted lines, it would constitute a two standard deviation event, which would represent higher than expected risk based on the historical experience.
- The historical return patterns above are in-line with expectations on a historical basis.

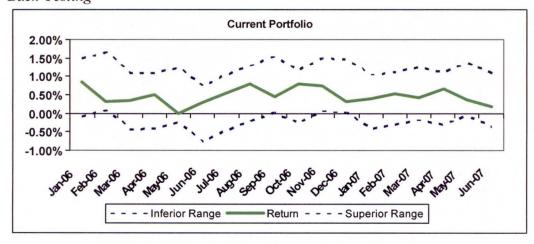
Fund Y

Growth of a Dollar – 2002 to 2007

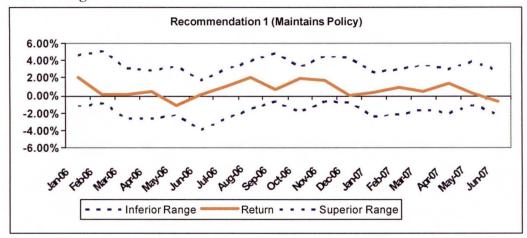


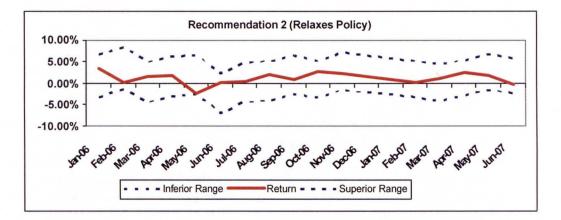
- This analysis represents the growth of assets over five years based on the historical returns of representative indices for each of the portfolios. It assumes an initial value of \$1.3 billion (USD) as of June 30, 2002, and no contributions or distributions.
- If the investment restrictions were relaxed over this time period to reflect the recommendation for this program (Recommendation 2), the Fund would have realized an excess of \$300 million over the last five years.
- As was mentioned in the Fund X portfolio analysis, we do not believe historical performance is a good indication of future results; however, we think this analysis helps illustrate the opportunity set afforded by considering the introduction of riskier asset classes in the portfolio.

Back-Testing



Back-Testing





- This analysis includes a statistical representation of the portfolio's range of possible investment returns, assuming a normal distribution of returns. This analysis can be completed in many different ways, but for purposes of the illustration above, we used monthly return data frequency and rolling five-year standard deviations. While these exhibits show a range of returns of one and one-half years, we actually covered a period of five years to calculate the rolling five-year standard deviations.
- The red line represents monthly returns ranging from January 2006 to June 2007. The dotted blue lines above and below the red line exhibit rolling 5-year standard deviation of returns over the prior month (also calculated using monthly frequency), which represent two standard deviations away from the mean and theoretically accounts for approximately 95% of possible return outcomes.
- If a return falls outside the dotted lines, it would constitute a two standard deviation event, which would represent higher than expected risk based on the historical experience.
- The historical return patterns above are in-line with expectations on a historical basis.

Deterministic Economic Scenarios

Favorable and Unfavorable Environments

The exhibits that follow below summarize the nominal returns and market values of the current and recommended portfolios for both Funds. We provide commentary on the results on the following page.

Fund X

		Portfol	ios - Fund X
	Returns and Terminal Values	Current	Recommendation
ts	Ideal Growth Average Nominal Return (USD) Terminal Value (USD) in Billions Average Nominal Return Terminal Value in Trillions	4.0% \$34.8 5.1% \$ 20.0	7.6% \$34.8 8.7% \$ 20.0
Expected Results	Base Case Average Nominal Return (USD) Terminal Value (USD) in Rillions Average Nominal Return Terminal Value	4.6% \$15.0 5.9% \$ 8.8	6.5% \$15.0 7.8% \$ 8.8
Û	Stagflation Average Nominal Return (USD) Terminal Value (USD) in Billions Average Nominal Return Terminal Value	5.9% \$2.3 9.0% \$ 1.6	5.5% \$2.3 8.5% \$1.6

Fund Y

			Portfolios - Fun	d Y
	Returns and Terminal Values	Current	Recommendation 1 (Maintains Policy)	Recommendation 2 (Relaxes Policy)
ts	Ideal Growth Average Nominal Return (USD) Terminal Value (USD) in Billions Average Nominal Return Terminal Value in Trillions	4.0% \$15.5 5.0% \$ 9	7.4% \$17.6 8.5% \$ 10	9.1% \$18.6 10.2% \$ 11
Expected Results	Base Case Average Nominal Return (USD) Terminal Value (USD) in Billions Average Nominal Return Terminal Value in Trillions	4.6% \$14.2 5.9% \$.8	6.3% \$15.5 7.6% \$ 9	7.2% \$16.1 8.5% \$ 9
Ĥ	Stagflation Average Nominal Return (USD) Terminal Value (USD) in Billions Average Nominal Return Terminal Value in Trillions	5.9% \$6.3 9.0% \$4	5.5% \$6.3 8.5% \$.4	5.0% \$6.2 8.0% \$ 4

Favorable and Unfavorable Economic Environments

The exhibits on the previous page present the behavior of each of the portfolios under three economic scenarios, considering expected average returns in each environment and the resulting terminal value of each Fund. The results of this analysis are shown in nominal terms and are expressed in both USD and Currency X terms. This analysis includes three different economic scenarios, as follows:

- Base Case The base case assumes nominal GDP growth of 8% (5% real), inflation of 3% and the commodity price appreciation of 4% for each year.
- Ideal Growth The ideal growth scenario assumes 11-12% nominal GDP growth, inflation of 2% and the commodity price appreciation of 4-10% for each year.
- Stagflation The stagflation scenario assumes 0.5% to 5% nominal GDP growth, inflation of 4-5% and a decline in the commodity price of up to 15% in the first year to a price appreciation of 3% in the latter years.

The terminal value of each of the Funds is higher in the ideal growth environment, as we expected, given strong GDP growth and rising the commodity price expectations, leading to larger contributions to each of the Funds and stronger returns, which further bolster the ending value in the year 2017. Results for the recommended portfolios show more attractive results in terms of returns and terminal values.

The expected annual returns are initially high in the ideal growth scenario and then decrease in later years as the effects of strong GDP growth and lower interest rates get priced into various asset classes. The opposite effect is true in the stagflation environment.

Sensitivity Analysis

We conducted stress test analysis considering high, medium (base case), and low correlation assumptions between the commodity price, Country X real GDP growth, and global equities. Here are the correlation assumptions tested in relation to the commodity price:

Asset Class Variables	Correlation Assumptions					
	Low	Medium	High			
Country X GDP Growth (Real)	0.03	0.21	0.27			
Global Equity	0.05	0.29	0.47			

We found there was no impact to the expected returns and volatility comparing the base case (medium) to the high and low correlation assumptions. However, we did notice an impact to contribution levels for Fund X and Fund Y. Hence, we focused the analysis on the behavior of contribution patterns (cash inflows) for each for the Funds. The results are summarized below for the assumed high, medium, and low correlation sets tested in this analysis.

FUND X

Fund X - Total Contributions in USD millions (Correlation - High)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1,574.9	2,343.8	2,949.9	4,615.3	5,466.6	6,509.6	7,628.6	8,904.3	9,983.2	11,632.4
75th perc.	549.7	872.6	1,121.0	2,321.9	2,656.2	3,010.7	3,285.3	3,804.9	4,255.8	4,896.1
50th perc.*	0.0	0.0	0.0	796.4	978.9	970.8	954.6	1,148.5	1,263.6	1,602.3
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}median

Fund X - Total Contributions in USD millions (Correlation - Base)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1,570.2	2,335.8	2,909.0	4,592.3	5,406.8	6,366.4	7,525.6	8,634.4	9,575.6	11,309.8
75th perc.	548.3	868.8	1,111.0	2,306.2	2,639.5	3,027.0	3,288.7	3,792.7	4,177.6	4,839.2
50th perc.*	0.0	0.0	0.0	794.9	977.2	974.8	955.3	1,151.4	1,285.5	1,603.9
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Fund X - Total Contributions in USD millions (Correlation - Low)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1,555.9	2,282.9	2,798.6	4,461.2	5,218.2	6,021.0	7,070.2	8,273.4	9,125.6	11,042.0
75th perc.	534.0	847.3	1,098.7	2,243.9	2,568.8	2,950.2	3,221.9	3,714.0	4,160.0	4,802.4
50th perc.*	0.0	0.0	0.0	801.5	997.2	1,008.2	1,011.5	1,238.8	1,381.5	1,703.8
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}median

Observations:

- The difference in contributions between the *high* and *medium* correlations are small from the 25th to 75th percentiles. Only in the 75th to 95th percentiles do we begin to see more noticeable differences.
- By comparison, the expected contributions between medium and low correlation results is noticeable across a larger portion of the data range, from the 50th to 95th percentiles.
- The contribution levels for the *low* correlation set are the highest while contribution levels for the *high* correlation set of results are the lowest.
- As expected, the higher the correlation, the greater the range of contributions. As in portfolio theory, high correlation produces a higher variability of outcomes. When the commodity is more highly correlated with economic growth and equity returns, the investments globally do not offer as strong a diversification benefit. Under the high correlation scenarios, as the commodity prices increase rapidly, so does economic growth and global equity returns. Conversely, when the commodity prices decline, there is a higher probability of low economic growth (hence, low contributions) and lower equity returns.

FUND Y

FUND Y - Total Contributions in USD millions (Correlation - High)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	895.9	963.2	1,068.7	1,176.3	1,322.0	1,492.3	1,694.0	1,916.3	2,190.1	2,489.9
75th perc.	772.6	833.8	909.8	995.5	1,110.6	1,215.3	1,338.1	1,478.1	1,630.2	1,812.6
50th perc.*	699.6	747.7	806.9	878.0	952.8	1,011.6	1,081.5	1,187.7	1,265.7	1,386.3
25th perc.	577.0	416.2	410.0	404.2	441.5	462.8	501.5	542.2	571.3	656.5
5th perc.	276.8	280.9	295.3	306.7	317.3	328.9	342.7	347.2	364.3	370.6

^{*}median

FUND Y - Total Contributions in USD millions (Correlation - Base)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	895.4	963.2	1,068.7	1,176.0	1,320.6	1,492.3	1,694.0	1,916.2	2,190.1	2,489.9
75th perc.	772.6	833.9	909.6	995.7	1,110.6	1,215.3	1,335.2	1,475.5	1,630.2	1,813.7
50th perc.*	699.9	746.8	806.9	878.0	953.7	1,012.6	1,081.8	1,187.7	1,267.9	1,386.0
25th perc.	578.0	410.1	414.3	409.6	444.2	468.5	509.8	544.2	577.0	659.8
5th perc.	277.0	280.9	295.3	307.4	317.3	329.0	344.4	347.8	364.5	371.3

^{*}Median

FUND Y - Total Contributions in USD millions (Correlation - Low)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	895.4	964.1	1,068.7	1,175.8	1,320.6	1,492.2	1,693.6	1,916.2	2,190.1	2,480.4
75th perc.	772.7	834.2	909.4	996.4	1,109.5	1,214.3	1,333.6	1,474.5	1,624.2	1,806.9
50th perc.*	700.3	747.7	808.5	878.6	954.2	1,012.8	1,084.0	1,185.9	1,269.1	1,388.1
25th perc.	581.4	428.7	420.0	415.9	458.8	487.2	526.8	571.5	610.0	706.8
5th perc.	277.0	281.0	296.9	308.2	319.1	331.0	349.0	351.7	370.6	380.2

^{*}median

- The difference in contributions between the high, medium, and low correlation sets are less noticeable across the data range for the Fund Y.
- The pattern observed above is due to the fact that the contributions for the Fund Y are less sensitive to the commodity price and Country X GDP growth, since this Fund is guaranteed at least 0.2% of the Country X GDP in contributions each year regardless of economic circumstances in Country X.
- We see a similar pattern for Fund Y: as correlation of the commodity with economic growth and equity returns increases, the range of outcomes increases. Again this is consistent with standard portfolio theory that low correlation is desirable because it reduced portfolio volatility.

8

Appendix

- I. Broad Asset Allocation of Other National Pension Funds
- II. Quantitative Methodology
- III. Capital Markets Assumptions (Currency X)
- IV. Mean Variance Analysis (Currency X)
- V. Mean Variance Analysis (USD) Excluding Alternatives
- VI. Mean Variance Analysis (Currency X) Excluding Alternatives
- VII. Monte-Carlo Simulation Results (USD)
- VIII. Monte-Carlo Simulation Results (Currency X)
- IX. Index Descriptions
- X. Discount Rate and Duration Calculations
- XI. Proposed Implementation Strategy

I. Broad Asset Allocation of Other National Funds (based on most recent available public disclosures by each Fund)

	Fund Size (USD bn)	Equities (%)	Fixed Income (%)	Alternatives (%)	Cash/Other (%)
Aus Gov PF	7	70	18	10	2
Norwegian PF	300	40	60	-	-
New Zealand PF	10	50	15	35	-
Ireland PF	25	70	12	16	2
Japan PF	100	56	44	-	-

II. Quantitative Methodology – Historical Data and General Descriptions

Lagged Correlation Analysis - Summary Results

	T	T+1	T+2	T+3	T+4	T+5
Average Correlation	0.07	0.12	0.07	0.10	0.08	0.11
Std. Dev. Of Correlation	0.12	0.11	0.13	0.11	0.17	0.09

	T-1	T-2	T-3	T-4	T-5
Average Correlation	-0.01	-0.20	0.01	0.05	0.04
Std. Dev. Of Correlation	0.11	0.07	0.12	0.14	0.11

Range of Correlation	
(covering 95% of the data)*	-0.12 to 0.27

^{*}Assuming a normal distribution.

This analysis shows rolling five-year correlations between the Dow Jones Commodity Index and Country X GDP growth. This analysis demonstrates that the correlation between these two factors has been weak historically, even when we lag one of the variables relative to the other. For example, T represents correlation calculations that used the same time period for the Dow Jones Commodity Index and Country X GDP growth (we also describe this as coincident correlation analysis). T+1 represents time periods where we lagged the Dow Jones Commodity Index relative to Country X GDP growth by one quarter, T+2 represents a lag of two quarters, and T+3 through T+5 follow the same pattern. Similarly, T-1 represents time periods where we lagged Country X GDP growth relative to the Dow Jones Commodity Index by one quarter, T-2 represents a lag of two quarters, and T-3 through T-5 follow a corresponding pattern

 $Lagged\ Correlation\ Analysis\ (Dow\ Jones\ Commodity\ Index_{t}\ and\ Country\ X\ GDP_{t+y;\ t-y})$

T	T+1	T+2	T+3	T+4	T+5
0.24	0.06	0.06	-0.08	0.32	-0.04
0.24	0.08	0.05	-0.09	0.32	-0.03
0.27	0.03	0.09	-0.09	0.36	0.01
0.15	0.09	0.07	0.04	0.38	0.07
0.16	0.10	0.03	0.06	0.40	0.08
0.16	0.10	0.06	0.12	0.44	0.02
0.11	0.14	0.12	0.15	0.37	0.08
0.11	0.15	0.11	0.25	0.25	0.06
0.12	0.15	0.18	0.17	0.25	0.05
0.08	0.29	0.18	0.00	0.17	0.15
0.09	0.31	0.16	-0.02	0.17	0.17
-0.01	0.17	0.08	0.18	0.02	0.10
-0.01	0.17	0.14	0.12	0.02	0.10
-0.03	0.22	0.11	0.10	0.01	0.12
-0.09	0.29	0.10	0.10	-0.08	0.18
-0.13	0.30	0.10	0.15	-0.12	0.19
-0.12	0.29	0.15	0.10	-0.11	0.19
-0.10	0.25	0.22	0.11	-0.04	0.17
0.00	0.17	0.23	0.10	0.03	0.07
-0.11	0.18	0.17	0.17	-0.11	0.11
-0.14	0.10	0.15	0.15	-0.08	0.08
-0.17	0.12	0.11	0.17	-0.10	0.13
-0.12	0.08	0.09	0.17	-0.09	0.05
0.10	0.05	0.18	-0.02	-0.08	0.01
0.10	0.04	0.20	-0.01	-0.07	0.02
0.14	-0.06	0.21	-0.02	-0.06	-0.04
0.08	-0.01	0.22	0.00	-0.09	0.02
0.19	0.00	0.25	-0.13	0.16	-0.03
0.17	0.05	0.10	0.10	0.10	0.05
0.15	0.15	-0.10	0.14	0.07	0.22
0.12	0.19	-0.11	0.19	0.00	0.24
0.13	0.19	-0.10	0.17	0.01	0.24
0.12	0.19	-0.16 -0.14	0.25	0.00	0.25 0.23
0.12 0.07	0.17 0.17		0.25 0.27	0.00 -0.05	0.23
0.07	0.17	-0.13 -0.10	0.27	0.13	0.26
0.21	0.10	-0.10	0.03	0.13	0.20
0.20	-0.15	-0.33	0.20	0.13	
0.23	-0.13	-0.03	0.21		
0.14	-0.09	-0.10			
0.05	-0.17				

Lagged Correlation Analysis (Dow Jones Commodity Index $_t$ and CountryGDP $_{t+y;\,t-y}$) (Continued)

T-1	T-2	T-3	T-4	T-5
-0.27	-0.11	0.00	0.14	-0.10
-0.29	-0.15	0.01	0.13	-0.10
-0.18	-0.19	0.00	0.08	0.00
-0.15	-0.19	0.04	-0.01	-0.06
-0.11	-0.18	0.07	0.01	-0.13
-0.11	-0.19	0.06	0.01	-0.13
0.02	-0.10	0.04	-0.02	-0.02
0.03	-0.17	0.03	-0.07	-0.01
-0.08	-0.19	-0.05	-0.05	-0.03
-0.09	-0.27	-0.04	-0.07	-0.04
0.12	-0.24	0.00	-0.11	-0.02
0.05	-0.25	0.07	-0.15	-0.07
0.01	-0.29	0.11	-0.13	0.06
0.00	-0.27	0.12	-0.07	0.05
0.02	-0.24	0.04	0.00	0.20
-0.03	-0.19	-0.05	-0.12	0.17
0.03	-0.19	-0.11	-0.21	0.15
0.02 0.13	-0.24	-0.15	-0.22	0.16
0.13	-0.24 -0.29	-0.11	-0.16	-0.02
0.11	-0.29	-0.13 -0.16	0.01 0.00	-0.03 -0.04
0.11	-0.20	-0.16	0.00	
0.02	-0.19	-0.17	-0.01	-0.03 -0.23
0.02	-0.19	-0.24	0.29	0.23
-0.01	-0.07	-0.17	0.23	0.07
0.01	0.01	-0.08	0.16	0.11
-0.24	-0.21	0.12	0.12	0.11
-0.09	-0.26	0.17	0.13	0.11
-0.07	-0.22	0.18	0.11	0.11
-0.04	-0.22	0.18	0.11	0.14
-0.04	-0.26	0.17	0.10	0.04
0.04	-0.25	0.18	0.28	0.23
0.04	-0.25	0.14	0.24	0.16
0.09	-0.19	0.18	0.29	0.13
-0.07	-0.35	-0.07	0.24	0.21
0.07	-0.14	0.02	0.20	0.19
0.05	-0.16	0.01	0.20	
0.05	-0.19	0.01		
0.16	-0.16			
0.14				

About Mercer's Capital Market Simulator

Mercer's Capital Markets Simulator (CMS) is used to generate economic and capital market variables to be used in simulation work in asset/liability and asset allocation assignments.

The model has two parts to the generation of data:

- 1. Part 1 generates all of the "basic" variables: inflation, yields, economic/earnings growth, for each country or region being modeled.
- 2. Part 2 takes these basic results and recasts them into the final variables needed for analysis.

Mercer Global Economic & Capital Market Model

Basic Description

Mercer's global economic model is used to analyze and simulate the capital markets.

Important Features

Some of the important features of the Mercer model are the following:

- 1. By generating bond yields directly, these yields can be used to calculate bond returns and liability discount rates. This ensures consistency between calculation of asset classes and valuation of liabilities when necessary.
- 2. It is a global model. By specifying several countries and/or regions, inflation, economic growth, and inflation are generated simultaneously across all regions. This allows for consistency in determination of exchange rates as well as correlation between regions.
- 3. Equity returns are determined by earnings growth, dividend yields, and changes in P/E ratios. This approach is consistent with the prevailing economic theory of equity valuation; the dividend discount model.
- 4. The model relies upon both *growth* functions and *yield* functions. These equations are very similar, but they have one huge difference: growth functions can have negative values, while yield functions can never generate a negative value. Thus, yield functions are ideal for modeling interest rates since they never allow interest rates to become negative; and growth functions are ideal for inflation, earnings growth, and real wages.

By adjusting the parameters of the model, scenario analysis permits a better understanding of what can cause adverse events in the capital markets.

In general, the model follows the following broad steps.

Strategic Asset Allocation Analysis

Step 1. Generate Inflation

Inflation is calculated simultaneously across countries and regions being modeled. The proper correlation is taken into account between the regions. Inflation can be modeled several ways and a full discussion of the different techniques is presented later.

Step 2. Generate Economic/Earnings Growth

This is real (net of inflation) economic growth, which is determined by inflation variables, expected long run growth, and lagged growth. Growth across countries and regions is determined simultaneously with the proper correlation taken into account between the regions.

Earnings growth for the different equity asset classes is determined directly from economic growth. It is normally set up as linear function of economic growth and the error terms can be handled by a correlated random variable.

Step 3. Generate Real Wage Growth

Real wage growth is determined as a function of inflation and real economic growth. This can be correlated across regions.

Step 4. Generate Real, Nominal, and Equity Yields

One key yield for each of real, nominal, and equity yields are generated simultaneously across all regions, which means that correlation between the three within a region as well as across regions is taken into account. For the U.S., these key yields are the 30-year Treasury bond yield, the 30-year inflation-indexed bond yield (TIPS), and the S&P 500 equity yield.

Note that the equity yield is the inverse of the P/E. Hence, we are modeling an important component of the equity market. As a side calculation, the dividend yield is calculated based upon the errors terms used for the equity yields.

Step 5. Construct Yield Curves

The nominal and real yield curves are constructed. The long-term values for each point on the yield curve as well as the relative volatilities are used. Using this approach, it is possible to generate inverted yield curves.

Step 6. Calculate government bond returns

The returns for government bonds can be calculated precisely given the beginning-of-year yields and end-of-year yields.

Step 7. Calculate Equity Returns

Equity returns are exactly determined by earnings growth, changes in equity yields, and the dividend yield.

As a side calculation, corporate bond yields can be set as a function of equity returns. As equity returns rise above average, corporate spreads over treasuries decline; when equity returns are below average, corporate spreads rise. Once corporate bond yields have been determined, returns for corporate bonds can be calculated.

Step 8. Determine Exchange Rates

The default setting we recommend for determination of exchange rates is interest rate parity theory. This means that exchange rates are expected to change to equalize expected returns across regions. A random variable is added to this change. Another method of modeling exchange rates is purchasing power parity, in which exchange rates change around a predefined amount. An extreme case of this is purely random exchange rates.

Step 9. Compute international returns

Given the local returns of equity and fixed income in each region and the changes in exchange rates, we can compute the returns of international investing for each region

Modeling Inflation

There are several ways to model inflation. Each has features that are appealing, but each also has features that are not satisfactory. The three specific models of inflation are:

- 1. Mean-reverting, serially correlated growth function. In this process, this year's inflation is determined by last year's inflation and the long run expected value (mean) of inflation. Inflation generated by this process produces very symmetric inflation series with correct serially correlated values. Since inflation typically exhibits high serial correlation, this process is attractive for modeling stable inflation environments. However, this process never produces huge jumps in inflation or hyperinflation
- 2. Actual inflation is a random variable around expected inflation, and expected inflation is measured by the difference between nominal and real interest rates at the beginning of the year. Theoretically, this process has a great deal of economic appeal, as it stipulates that investors use the capital markets to reveal expected inflation. In practice, this process can easily produce hyperinflation. However, the problems of using such an approach are that inflation typically loses any serial correlation and when a hyperinflation occurs, it never stops. I.e., there is no mean-reverting process to inflation
- 3. A modified mean-reverting, serially correlated yield function. By modifying the general yield functions, we can bring back serial correlation and set an upper bound to hyperinflations. However, this process still has some faults. It has the reverse property of the second method: once an economy falls into a low inflation environment, it never comes out of it and continues to experience year and after year of negligible inflation.

Each of these methods for modeling inflation has its advantages and disadvantages. The growth function process produces very predictable ranges of inflation, but fails to ever simulate a hyperinflation. The second method listed above can produce episodes of hyperinflation, but these hyperinflations never revert back to normal inflation levels. This method also produces too little serial correlation. The third method listed above produces too little changes in inflation from year-to-year, but possess appealing serial correlation characteristics. In practice, we used scenario analysis to evaluate the sensitivity of each strategy to various types of inflation environments.

Mean-Reverting, Serially Correlated Functions

Many of the variables generated in Mercer's model are mean-reverting, serially correlated, lognormally distributed random variables. What this means is that a random variable is determined by the following factors:

- Long-term mean: This is the long-term trend towards which the variable reverts when it starts to deviate from the long-term mean. For example, the 30-year treasury yield may be set to have a long-term mean of 5.50%. If interest rates go up to 7.0%, then the equation is designed to pull yields back towards 5.50% over time by a certain amount.
- Lagged value: Last year's value partially determines this year's value.

Listed below is a general "yield function"

$$\ln(Y_{t}) = b1_{Y} \cdot \ln\left(\frac{1 + AI_{t}}{1 + \mu_{AI}}\right) + b2_{Y} \cdot \ln\left(\frac{1 + AI_{t}}{1 + AI_{t-1}}\right) + b3_{y} \cdot \ln\left(\frac{1 + EG_{t}}{1 + \mu_{EG}}\right) + b4_{y} \cdot \ln\left(\frac{1 + EG_{t}}{1 + EG_{t-1}}\right)$$

$$+ (1 - r_{Y}) \cdot \ln Y_{t-1} + r_{Y} \cdot \ln \mu_{Y} + \varepsilon_{Y,t}$$

The mean-reversion, serial correlation component is shown in the second line of the equation.

The term r_y is the mean-reversion factor. For example if r_y is set at 0.7, then 70% of the new value of the variable is determine by the logarithm of its mean (μ_y) and 30% by the logarithm of its lagged value.

The first line of the equation specifies how sensitive the variable is to mean-inflation, lagged inflation, the actual inflation (AI), and economic growth factors (EG). By setting the b1, b2, b3, and b4 coefficients to zero, inflation and economic growth could have no effect on the variable.

The above equation is called a yield equation because in its particular form, no negative values can result. This is perfect for modeling interest rates, as it sets a lower bound for interest rates at zero. A slightly different form of this equation is called a "growth function" and it allows for negative values of the variable. This form of the equation is suited to modeling actual inflation, economic growth, earnings growth, and wage growth, since these could all be negative.

Summary

The Mercer global economic model of the capital markets goes beyond the typical meanvariance modeling of asset classes. By explicitly modeling interest rates, earnings yields, and earnings growth, as well as doing this simultaneously across several countries or regions, we derive a more realistic model of the capital markets.

Mathematical Formulation

This portion of the appendix covers the mathematical formulation of all calculations of CMS.

General Description

The general process for generating the economic and capital market inputs for the Mercer Global Asset/Liability Model is:

- Generate the actual inflation for an economy based on beginning of year real and nominal
 interest rates and cross-correlation with other countries. (An option is available to model
 actual inflation as a mean-reverting, serially correlated process instead.)
- Generate real equity/earnings growth for the year based on inflation factors, meanreversion and serial correlation factors, and cross-correlation with other countries.
- Generate real wage growth for the year based on actual inflation factors, real equity/earnings growth factors, mean-reversion and serial correlation factors.
- Generate the 30-year nominal yield, the 30-year real yield and the equity/earnings yield based on inflation and real earnings/economic growth factors, mean-reversion and serial correlation factors, and cross-country correlation factors.
- Compute the rest of the yield curve. The current model uses the Bader-Finney process for generating the rest of the real and nominal yields.
- Compute actual returns for nominal and real par bonds on each point modeled on the yield curves.
- Generate changes in exchange rates based on interest rate parity or inflation parity conditions.

These outputs should be sufficient for modeling of multiple countries or multiple regions for asset liability work.

Model Generalities

In general, the model relies upon two types of equations:

- Growth rate equations that determine actual inflation (optional), real earnings/economic growth, and real wage growth. These equations are constructed so that growth rates can become negative.
- Yield equations that determine real yields, nominal yields, and equity yields.

The general form of the growth rate for variable X in year t is:

$$\ln(1+X_{t}) = b1_{x} \cdot \ln\left(\frac{1+AI_{t}}{1+\mu_{AI}}\right) + b2_{x} \cdot \ln\left(\frac{1+AI_{t}}{1+AI_{t-1}}\right) + b3_{x} \cdot \ln\left(\frac{1+EG_{t}}{1+\mu_{EG}}\right) +$$

$$b4_{x} \cdot \ln \left(\frac{1 + EG_{t}}{1 + EG_{t-1}} \right) + (1 - r_{x}) \cdot \ln(1 + X_{t-1}) + r_{x} \cdot \ln(1 + \mu_{x}) + \varepsilon_{x,t}$$
 (1)

where AI, is actual inflation in year t,

 μ_{AI} is the long run value (mean) of actual inflation,

 μ_{EG} is the long run value (mean) of real earnings/economic growth,

r, is the mean reverting rate for X,

 $b1_x$ and $b2_x$ are coefficients defining the direction and speed of adjustment of X to actual inflation, long run inflation, and lagged inflation,

b3_x and b4_x are coefficients defining the direction and speed of adjustment of X to real earnings growth, long run earnings/economic growth, and lagged earnings/economic growth,

 μ_X is the long run value (mean) of X, and

 $\varepsilon_{\rm x,t}$ is the appropriate error term.

Growth rate functions have the following properties:

- They are mean-reverting, serially correlated, logarithmically distributed.
- Because the logarithm is based on the "wealth relative" value $(1 + X_t)$, the variable can be negative.

Yield functions follow a similar form:

$$\ln(Y_{t}) = b1_{Y} \cdot \ln\left(\frac{1 + AI_{t}}{1 + \mu_{AI}}\right) + b2_{Y} \cdot \ln\left(\frac{1 + AI_{t}}{1 + AI_{t-1}}\right) + b3_{y} \cdot \ln\left(\frac{1 + EG_{t}}{1 + \mu_{EG}}\right) + b4_{y} \cdot \ln\left(\frac{1 + EG_{t}}{1 + EG_{t-1}}\right) + (1 - r_{Y}) \cdot \ln Y_{t-1} + r_{Y} \cdot \ln \mu_{Y} + \varepsilon_{Y,t}$$
(2)

Yield functions are similar to growth functions in that they are mean-reverting, serially correlated and logarithmically distributed, but because of their form, they can never be negative.

Model Specifics

Inflation is modeled off expected inflation as revealed by the difference between the 3-month nominal yield and 3-month real yield:

$$AI_{t} = \frac{1 + I_{3m,t-1}}{1 + RY_{3m,t-1}} + \varepsilon_{AI,t}$$
(3)

Earnings/economic growth is similarly simplified to:

$$\ln(1 + EG_t) = b1_{EG} \cdot \ln\left(\frac{1 + AI_t}{1 + \mu_{AI}}\right) + b2_{EG} \cdot \ln\left(\frac{1 + AI_t}{1 + AI_{t-1}}\right) +$$

$$(1 - r_{EG}) \cdot \ln(1 + EG_{t-1}) + r_{EG} \cdot \ln(1 + \mu_{EG}) + \varepsilon_{EG,t}$$
(4)

Inflation is mean reverting, serially correlated, and lognormally distributed.

The following variables and their functional form are modeled:

AI _t = actual inflation	Deterministic or
	growth function
EG_t = real earnings/economic growth	Growth function
$RW_t = real wage growth$	Growth function
$RY_{30,t}$ = real yield on 30-year inflation indexed bond	Yield function
$RY_{10,t}$ = real yield on 10-year inflation indexed bond	Deterministic
$RY_{5,t}$ = real yield on 5-year inflation indexed bond	Deterministic
$RY_{3m,t}$ = real yield on 3-month inflation indexed bond	Deterministic
I _{30,t} = nominal yield on the 30-year government bond	Yield function
I _{10,t} = nominal yield on the 10-year government bond	Deterministic
$I_{5,t}$ = nominal yield on the 5-year government bond	Deterministic
$I_{3m,t}$ = nominal yield on the 3-month government bond	Deterministic
EY, = equity (earnings) yield	Yield function
$ED_t = $ equity dividend yield	Yield function

These variables may have error terms that are correlated. The cholesky decomposition of the correlation matrix is used in stochastic simulation.

Nominal bond returns are determined by the same method as identified in Bader and Finney (1997).

The returns for inflation index bonds are determined by substituting real yields for nominal yields and multiplying the result by $(1 + AI_t)$.

Equity returns are determined by the following equation:

$$R_{EQ,t} = (1 + AI_{t}) \cdot (1 + EG_{t}) \cdot (1 + ED_{t}) \cdot \frac{EY_{t-1}}{EY_{t}} - 1$$
 (5)

Alternative Formation of Inflation:

Actual inflation is a simplified form of the general growth equation:

$$\ln(1 + AI_{+}) = (1 - r_{AI}) \cdot \ln(1 + AI_{+-1}) + r_{AI} \cdot \ln(1 + \mu_{AI}) + \varepsilon_{AI}$$
 (6)

Exchange Rates. We can model exchange rates using interest rate parity or inflation parity between two countries. Let the 3-month yield in Country A at the end of year t be designated as $I_{a,3m,t}$ and the inflation rate in year t be designated as $AI_{a,t}$. Using interest parity, the change in the exchange rate between Country A and Country B is defined as:

$$FX_{ab,t} = \frac{1 + I_{a,3m,t-1}}{1 + I_{b,3mt-1}} - 1 + \varepsilon_{FXab,t}$$
 (7)

Under the inflation parity assumption:

$$FX_{ab,t} = \frac{1 + AI_{a,3m,t}}{1 + AI_{b,3m,t}} - 1 + \varepsilon_{FXab,t}$$
(8)

Intercountry Correlation. Correlation between two countries is modeled through correlation of the error terms. This is done in stages as follows:

- Determine actual inflation as implied in Equation 3, but with $\varepsilon_{a,AI,t}$ now correlated now correlated with $\varepsilon_{b,AI,t}$.
- Determine real economic/earnings growth as implied in Equation 4, but with $\varepsilon_{a,PG,t}$ now correlated now correlated with $\varepsilon_{b,PG,t}$. [Note the correlation between inflation errors terms and productivity error terms need not be the same.]
- Determine real and nominal bond yields and equity yie lds as implied in Equation 5, but now with a cross-correlation matrix.

III. Capital Markets Assumptions in Currency X Terms

The information below refers to the mean variance analysis in currency x.

Asset Class	Absolute Return	Standard Deviation	
Global Equity	1	10.4%	15.0%
Global Government Bonds - Short/Intermediate	2	6.4%	11.0%
Global Government Bonds - Long	3	6.8%	12.0%
Global Corporate Bonds - Short/Intermediate	4	6.9%	11.0%
Global Corporate Bonds - Long	5	7.7%	12.0%
Global TIPS	6	6.7%	11.5%
Global Cash/Enhanced Cash	7	5.5%	10.5%
Global Private Equity	8	13.2%	25.9%
Global Real Estate	9	8.9%	12.5%
Global Infrastructure	10	10.4%	17.7%
Global Absolute Return/Opportunistic	11	8.4%	11.5%

		1	2	3	4	5	6	7	8	9	10	11
Global Equity	1	1		1100								
Global Government Bonds - Short/Intermediate	2	0.00	1									
Global Government Bonds - Long	3	0.00	0.96	1								
Global Corporate Bonds - Short/Intermediate	4	0.00	0.98	0.95	1							
Global Corporate Bonds - Long	5	0.00	0.95	0.97	0.94	1						
Global TIPS	6	0.00	0.95	0.97	0.94	0.96	1					
Global Cash/Enhanced Cash	7	0.00	0.97	0.93	0.97	0.91	0.90	1				
Global Private Equity	8	0.75	0.00	0.00	0.00	0.00	0.00	0.00	1			
Global Real Estate	9	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.55	1		
Global Infrastructure	10	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.30	1	
Global Absolute Return/Opportunistic	11	0.30	0.10	0.10	0.10	0.10	0.10	0.10	0.20	0.20	0.20	1

IV. Expected Return and Risk Characteristics of Candidate Portfolios in Currency X Terms (Mean Variance Analysis)

Candidate Portfolios in Currency X Terms - Shown for Illustrative Purposes Only (The recommendations appear in the Executive Summary)

FUND X – Asset Only

	Current	Potential Portfolio Considering Model in Currency X
Global Equity	0.00%	33.00%
Ghl Gov't Bonds - Short/Intermediate	66.30%	0.00%
Ghl Gov't Bonds - Long	0.00%	0.00%
Ghl Corp Bonds - Short/Intermediate	0.00%	30.00%
Gbl Corp Bonds - Long	0.00%	25.00%
Gbl Inflation Indexed Bonds	3.50%	0.00%
Gbl Cash/Enhanced Cash	30.20%	0.00%
Ghl Private Equity	0.00%	0.00%
Ghl Real Estate	0.00%	5.00%
Ghl Infrastructure	0.00%	2.00%
Ghl Absolute Return/Opportunistic	0.00%	5.00%
Expected Return (Arithmetic)	6.10%	8.49%
Standard Deviation	10.78%	8.51%
Expected Return (Geometric)	5.55%	8 16%
Max Annual Loss @ 95% Confidence Interval	-11.63%	-5.51%
Probability of Less Than 0% Return - One Year	30.32%	16.60%
Probability of Less Than 0% Return - Three Years	18.61%	4.65%
Probability of Less Than 0% Return - Five Years	12 46%	1.50%
Probability of Less Than 0% Return - Ten Years	5 16%	0.11%

FUND Y - Asset Only

	Current	Potential Portfolio Considering Model in Currency X(1)	Potential Portfolio Considering Model in Currency X (
Global Equity	0.00%	25.00%	70.00%
Gbl Gov't Bonds - Short/Intermediate	65.60%	0.00%	0.00%
Gbl Gov't Bonds - Long	0.00%	60.00%	0.00%
Ghl Corp Bonds - Short/Intermediate	0.00%	0.00%	0.00%
Ghl Corp Bonds - Long	0.00%	0.00%	15.00%
Ghl Inflation Indexed Bonds	3.40%	0.00%	0.00%
Ghl Cash/Enhanced Cash	31.00%	0.00%	0.00%
Ghl Private Equity	0.00%	5.00%	5.00%
Gbl Real Estate	0.00%	5.00%	3.00%
Gbl Infrastructure	0.00%	2.00%	2.00%
Gbl Absolute Return/Opportunistic	0.00%	3.00%	5.00%
Expected Return (Arithmetic)	6.09%	8 25%	9 97%
Standard Deviation	10.77%	9.11%	12 28%
Expected Return (Geometric)	5 55%	7 86%	9 29%
Max Annual Loss @ 95% Confidence Interval	-11.63%	-6.74%	-10.22%
Probability of Less Than 0% Return - One Year	30.01%	19.10%	22.21%
Probability of Less Than 0% Return - Three Years	18 20%	6.50%	9 26%
Probability of Less Than 0% Return - Five Years	12.06%	2.53%	4 36%
Probability of Less Than 0% Return - Ten Years	4.87%	0.29%	0.78%

FUND Y - Asset/Liability

	Current	Potential Portfolio Considering Model in Currency X (1	Potential Portfolio Considering Model) in Currency X (2
Global Equity	0.00%	25.00%	70.00%
Gbl Gov't Bonds - Short/Intermediate	65,60%	0.00%	0.00%
Gbl Gov't Bonds - Long	0.00%	60.00%	0.00%
Gbl Corp Bonds - Short/Intermediate	0.00%	0.00%	0.00%
Gbl Corp Bonds - Long	0.00%	0.00%	15.00%
Gbl Inflation Indexed Bonds	3.40%	0.00%	0.00%
Gbl Cash/Enhanced Cash	31.00%	0.00%	0.00%
Gbl Private Equity	0.00%	5.00%	5.00%
Gbl Real Estate	0.00%	5.00%	3.00%
Gbl Infrastructure	0.00%	2.00%	2.00%
Gbl Absolute Return/Opportunistic	0.00%	3,00%	5.00%
Expected Surplus Return (Arithmetic)	-4.64%	-2.49%	-0.76%
Surplus Standard Deviation	48.44%	49.55%	51.36%
Expected Surplus Return (Geometric)	-14.99%	-13.07%	-11.86%

Behavior of Strategic Allocations Identified in USD Terms in Currency X Mean Variance Space – Shown for Illustrative Purposes Only

FUND X – Asset Only

						D		
	Current	Eff Same	A	В	C	(Recommendation)	E	
Global Equity	0.00%	0.15%	10.00%	15.00%	20.00%	25.00%	30.00%	
Sbl Gov't Bonds - Short/Intermediate	66.30%	3.07%	0.00%	0.00%	0.00%	0.00%	0.00%	
ibl Gov't Bonds - Long	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
6bl Corp Bonds - Short/Intermediate	0.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	
Sbl Corp Bonds - Long	0.00%	0.00%	6.00%	10.00%	13.00%	17.00%	20.00%	
6bl Inflation Indexed Bonds	3.50%	10.92%	39.00%	30.00%	22.00%	13.00%	5.00%	
Sbl Cash/Enhanced Cash	30.20%	43.94%	0.00%	0.00%	0.00%	0.00%	0.00%	
Gbl Private Equity	0.00%	1.51%	4.00%	5.00%	5.00%	5 00%	5,00%	
Sbl Real Estate	0.00%	3.41%	4.00%	3.00%	3.00%	3.00%	3.00%	
Gbl Infrastructure	0.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	
Gbl Absolute Return/Opportunistic	0.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	
Expected Return (Arithmetic)	6.10%	6.54%	7.68%	7.95%	8.16%	8,39%	8.61%	
Standard Deviation	10.78%	9.50%	9.00%	8.83%	8.71%	8.70%	8.78%	
Expected Return (Geometric)	5.55%	6.11%	7.31%	7.59%	7.81%	8.04%	8.25%	
Max Annual Loss @ 95% Confidence Interval	-11.63%	-9.09%	-7.11%	-6.57%	-6.16%	-5.91%	-5.84%	
Probability of Less Than 0% Return - One Year	30.32%	25.99%	20.83%	19.50%	18.48%	17.75%	17.37%	
Probability of Less Than 0% Return - Three Years	18.61%	13.25%	7.97%	6.83%	6.01%	5.46%	5.18%	
Probability of Less Than 0% Return - Five Years	12.46%	7.51%	3.46%	2.73%	2.24%	1.93%	1.78%	
Probability of Less Than 0% Return - Ten Years	5.16%	2.09%	0.51%	0.33%	0.23%	0.17%	0.15%	

FUND Y - Asset Only

		A	U			
		Recommendation 1			Recommendation 2	
	Current	(Maintains Policy)	В	C	(Relaxes Policy)	E
Slobal Equity	0.0%	25.0%	25.0%	45.0%	50.0%	60.0%
Gbl Gov't Bonds - Short/Intermediate	65.6%	0.0%	0.0%	0.0%	0.0%	0.0%
Gbl Gov't Bonds - Long	0.0%	30.0%	0.0%	0.0%	0.0%	0.0%
6bl Corp Bonds - Short/Intermediate	0.0%	0.0%	60.0%	40.0%	35.0%	25.0%
Gbl Corp Bonds - Long	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sbl Inflation Indexed Bonds	3.4%	30.0%	0.0%	0.0%	0.0%	0.0%
Gbl Cash/Enhanced Cash	31.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Gbl Private Equity	0.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Sbl Real Estate	0.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Gbl Infrastructure	0.0%	2.0%	0.0%	0.0%	0.0%	0.0%
Gbl Absolute Return/Opportunistic	0.0%	3.0%	5.0%	5.0%	5.0%	5.0%
Expected Return (Arithmetic)	6.09%	8.20%	8.26%	8.96%	9.13%	9.48%
Standard Deviation	10.77%	8.95%	8.57%	9.47%	9.90%	10.95%
Expected Return (Geometric)	5.55%	7.84%	7.92%	8.55%	8.68%	8.93%
Max Annual Loss @ 95% Confidence Interval	-11.63%	-6.52%	-5.84%	-6.62%	-7.16%	-8.54%
Probability of Less Than 0% Return - One Year	30.01%	18.77%	17.47%	18.06%	18.75%	20.47%
Probability of Less Than 0% Return - Three Years	18.20%	6.23%	5.26%	5.69%	6.22%	7.65%
Probability of Less Than 0% Return - Five Years	12.06%	2.37%	1.82%	2.06%	2.36%	3.26%
Probability of Less Than 0% Return - Ten Years	4.87%	0.25%	0.15%	0.19%	0.25%	0.45%

FUND Y - Asset/Liability

		A	U .					
		Recommendation 1			Recommendation 2			
	Current	(Maintains Policy)	В	C	(Relaxes Policy)	E		
Global Equity	0.00%	25.00%	25.00%	45.00%	50.00%	60.00%		
Gbl Gov't Bonds - Short/Intermediate	65.60%	0.00%	0.00%	0.00%	0.00%	0.00%		
Gbl Gov't Bonds - Long	0.00%	30.00%	0.00%	0.00%	0.00%	0.00%		
Gbl Corp Bonds - Short/Intermediate	0.00%	0.00%	60.00%	40.00%	35.00%	25.00%		
Gbl Corp Bonds - Long	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		
Gbl Inflation Indexed Bonds	3.40%	30.00%	0.00%	0.00%	0.00%	0.00%		
Gbl Cash/Enhanced Cash	31.00%	0.00%	0.00%	0.00%	0.00%	0.00%		
Gbl Private Equity	0.00%	5.00%	5.00%	5.00%	5.00%	5.00%		
Gbl Real Estate	0.00%	5.00%	5.00%	5.00%	5.00%	5.00%		
Gbl Infrastructure	0.00%	2.00%	0.00%	0.00%	0.00%	0.00%		
Gbl Absolute Return/Opportunistic	0.00%	3.00%	5.00%	5.00%	5.00%	5.00%		
Expected Surplus Return (Arithmetic)	-4.64%	-2.53%	-2.47%	-1.78%	-1.60%	-1.26%		
Surplus Standard Deviation (Tracking Error)	48.44%	49.50%	49.09%	49.86%	50,09%	50.61%		
Expected Surplus Return (Geometric)	-14.99%	-13.10%	-12.89%	-12.42%	-12.31%	-12.12%		

V. Expected Return and Risk Characteristics of Candidate Portfolios in US Dollar Terms (Mean Variance Analysis) – Excluding Alternative Investments

Candidate Portfolios in USD Terms Excluding Exposure to Alternative Investments – Shown for Illustrative Purposes Only (The recommendations appear in the Executive Summary)

FUND X - Asset Only

	Current	Potential Portfolio Excluding Alternatives (modeled in USD)
Global Equity	0.00%	33.00%
Gbl Gov't Bonds - Short/Intermediate	66.30%	0.00%
Gbl Gov't Bonds - Long	0.00%	0.00%
Gbl Corp Bonds - Short/Intermediate	0.00%	30.00%
Gbl Corp Bonds - Long	0.00%	15.00%
Gbl Inflation Indexed Bonds	3.50%	22.00%
Gbl Cash/Enhanced Cash	30.20%	0.00%
Gbl Private Equity	0.00%	0.00%
Gbl Real Estate	0.00%	0.00%
Gbl Infrastructure	0.00%	0.00%
Gbl Absolute Return/Opportunistic	0.00%	0.00%
Expected Return (Arithmetic)	4.64%	6.97%
Standard Deviation	2.20%	7.22%
Expected Return (Geometric)	4.62%	6.73%
Max Annual Loss @ 95% Confidence Interval	1.02%	-4.90%
Probability of Less Than 0% Return - One Year	1.79%	17.20%
Probability of Less Than 0% Return - Three Years	0.01%	5.06%
Probability of Less Than 0% Return - Five Years	0.00%	1.72%
Probability of Less Than 0% Return - Ten Years	0.00%	0.14%

FUND Y - Asset Only

	Current	Potential Portfolio Excluding Alternatives (modeled in USD) (1)	Potential Portfolio Excluding Alternatives (modeled in USD) (2)
Global Equity	0.00%	25.00%	50.00%
Gbl Gov't Bonds - Short/Intermediate	65 60%	0.00%	0.00%
Gbl Gov't Bonds - Long	0.00%	75.00%	0.00%
Gbl Corp Bonds - Short/Intermediate	0.00%	0.00%	15.00%
Gbl Corp Bonds - Long	0.00%	0.00%	35.00%
Sbl Inflation Indexed Bonds	3.40%	0.00%	0.00%
Gbl Cash/Enhanced Cash	31.00%	0.00%	0.00%
Gbl Private Equity	0.00%	0.00%	0.00%
Gbl Real Estate	0.00%	0.00%	0.00%
Gbl Infrastructure	0.00%	0.00%	0.00%
Gbl Absolute Return/Opportunistic	0.00%	0.00%	0.00%
Expected Return (Arithmetic)	4.63%	6.57%	7.96%
Standard Deviation	2.18%	8.57%	10.52%
Expected Return (Geometric)	4.61%	6.23%	7.45%
Max Annual Loss @ 95% Confidence Interval	1.04%	-7.53%	-9.35%
Probability of Less Than 0% Return - One Year	1.55%	23.01%	23.65%
Probability of Less Than 0% Return - Three Years	0.01%	10.04%	10.70%
Probability of Less Than 0% Return - Five Years	0.00%	4.93%	5.43%
Probability of Less Than 0% Return - Ten Years	0.00%	0.98%	1.16%

FUND Y - Asset/Liability

	Current	Potential Portfolio Excluding Alternatives (modeled in USD) (1)	Potential Portfolio Excluding Alternatives (modeled in USD) (2)
Global Equity	0.00%	25.00%	50.00%
Gbl Gov't Bonds - Short/Intermediate	65.60%	0.00%	0.00%
Gbl Gov't Bonds - Long	0.00%	75.00%	0.00%
Gbl Corp Bonds - Short/Intermediate	0.00%	0.00%	15.00%
Gbl Corp Bonds - Long	0.00%	0.00%	35.00%
Gbl Inflation Indexed Bonds	3.40%	0.00%	0.00%
Gbl Cash/Enhanced Cash	31.00%	0,00%	0.00%
Gbl Private Equity	0.00%	0.00%	0.00%
Gbl Real Estate	0.00%	0.00%	0.00%
Gbl Infrastructure	0.00%	0.00%	0.00%
Gbl Absolute Return/Opportunistic	0.00%	0.00%	0.00%
Expected Surplus Return (Arithmetic)	-5.81%	-3.87%	-2.49%
Surplus Standard Deviation	50.70%	52 47%	51 91%
Expected Surplus Return (Geometric)	-17.07%	-15.62%	-13.92%

VI. Expected Return and Risk Characteristics of Candidate Portfolios in Currency X Terms (Mean Variance Analysis) – Excluding Alternative Investments

Candidate Portfolios in Currency X Terms Excluding Exposure to Alternative Investments – Shown for Illustrative Purposes Only (The recommendations appear in the Executive Summary)

FUND X - Asset Only

•		Potential Portfolio
	Current	Excluding Alternatives (modeled in Curren
Global Equity	0.00%	40.00%
Ghl Gov't Bonds - Short/Intermediate	66.30%	0.00%
Gbl Gov't Bonds - Long	0.00%	0.00%
Gbl Corp Bonds - Short/Intermediate	0.00%	30.00%
Ghl Corp Bonds - Long	0.00%	25.00%
Ghl Inflation Indexed Bonds	3 50%	0.00%
Ghl Cash/Enhanced Cash	30.20%	5.00%
Ghl Private Equity	0.00%	0.00%
Ghi Real Estate	0.00%	0.00%
Gbl Infrastructure	0.00%	0.00%
Gbl Absolute Return/Opportunistic	0.00%	0.00%
Expected Return (Arithmetic)	6.10%	8 41%
Standard Deviation	10.78%	9.00%
Expected Return (Geometric)	5 55%	8.04%
Max Annual Loss @ 95% Confidence Interval	-11 63%	-6 39%
Probability of Less Than 0% Return - One Year	30.32%	18.28%
Probability of Less Than 0% Return - Three Years	18 61%	5.86%
Probability of Less Than 0% Return - Five Years	12.46%	2.15%
Probability of Less Than 0% Return - Ten Years	5 16%	0.21%

FUND Y - Asset Only

	Current	Potential Portfolio Excluding Alternatives (modeled in Currency X) (Potential Portfolio Excluding Alternatives) (modeled in CurrencyX) (
Global Equity	0.00%	25.00%	80.00%
Ghl Gov't Ronds - Short/Intermediate	65.60%	0.00%	0.00%
Ghl Gov't Bonds - Long	0.00%	75.00%	0.00%
Ghl Corp Bonds - Short/Intermediate	0.00%	0.00%	0.00%
Ghl Corp Bonds - Long	0.00%	0.00%	20.00%
Ghl Inflation Indexed Bonds	3.40%	0.00%	0.00%
Gbl Cash/Enhanced Cash	31.00%	0.00%	0.00%
Gbl Private Equity	0.00%	0.00%	0.00%
Ghl Real Estate	0.00%	0.00%	0.00%
Gbl Infrastructure	0.00%	0.00%	0.00%
Ghl Absolute Return/Opportunistic	0.00%	0.00%	.0.00%
Expected Return (Arithmetic)	6.09%	7.70%	9.84%
Standard Deviation	10.77%	9.75%	12 24%
Expected Return (Geometric)	5 55%	7 26%	9.16%
Max Annual Loss @ 95% Confidence Interval	-11 63%	-8 33%	-10.29%
Probability of Less Than 0% Return - One Year	30.01%	22.50%	22.45%
Probability of Less Than 0% Return - Three Years	18.20%	9.54%	9.49%
Probability of Less Than 0% Return - Five Years	12 06%	4 56%	4 52%
Probability of Less Than 0% Return - Ten Years	4 87%	0.85%	0.83%

FUND Y - Asset/Liability

	Current	Potential Portfolio Excluding Alternatives (modeled in Currency X) (1	Potential Portfolio Excluding Alternatives) (modeled in CurrencyX) (;
Global Equity	0.00%	25.00%	80.00%
Gbl Gov't Bonds - Short/Intermediate	65.60%	0.00%	0.00%
Gbl Gov't Bonds - Long	0.00%	75.00%	0.00%
Gbl Corp Bonds - Short/Intermediate	0.00%	0.00%	0.00%
Gbl Corp Bonds - Long	0.00%	0.00%	20.00%
Gbl Inflation Indexed Bonds	3.40%	0.00%	0.00%
Gbl Cash/Enhanced Cash	31.00%	0.00%	0.00%
Gbl Private Equity	0.00%	0.00%	0.00%
Gbl Real Estate	0.00%	0.00%	0.00%
Gbl Infrastructure	0.00%	0.00%	0.00%
Gbl Absolute Return/Opportunistic	0.00%	0.00%	0.00%
Expected Surplus Return (Arithmetic)	-4.64%	-3.03%	-0.89%
Surplus Standard Deviation	48.44%	49.44%	51 39%
Expected Surplus Return (Geometric)	-14.99%	-13.61%	-12.02%

VII. Monte-Carlo Simulation Results in US Dollar Terms

FUND X

Current Portfolio

Nominal Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	9,679.2	11,663.8	14,122.9	18,306.2	23,316.7	28,618.8	34,968.0	42,183.4	50,821.1	61,175.9
75th perc.	8,657.3	9,440.9	10,539.5	12,566.6	14,968.4	17,840.5	20,794.6	24,377.7	28,010.9	32,361.8
50th perc.*	8,109.0	8,385.8	8,677.9	9,560.7	10,639.0	11,755.9	12,839.3	14,178.9	15,499.7	17,467.6
25th perc.	8,109.0	7,986.8	7,674.5	7,406.3	7,163.2	7,043.7	6,644.2	6,461.5	6,175.0	6,370.8
5th perc.	7,310.9	6,134.6	4,636.5	2,812.7	1,335.8	0.0	0.0	0.0	0.0	0.0

^{*}Median

Real Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	9,386.4	10,954.2	12,976.6	15,711.2	19,630.5	23,516.8	28,219.3	33,642.7	39,016.8	44,812.9
75th perc.	8,420.2	8,999.2	9,750.3	10,914.5	12,797.5	15,017.3	17,000.7	19,538.9	22,069.1	24,627.4
50th perc.*	7,998.7	8,011.3	8,087.5	8,442.6	9,140.9	9,885.9	10,528.2	11,356.4	12,361.3	13,428.8
25th perc.	7,876.6	7,583.4	7,180.3	6,717.9	6,412.5	6,038.2	5,494.5	5,340.6	4,897.8	4,868.6
5th perc.	7,178.6	5,966.3	4,371.5	2,587.1	1,226.1	0.0	0.0	0.0	0.0	0.0

^{*}Median

Nominal Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	7.4%	6.2%	6.0%	6.1%	6.2%	6.2%	6.2%	6.2%	6.2%	6.2%
75th perc.	6.0%	5.5%	5.3%	5.3%	5.3%	5.3%	5.3%	5.2%	5.2%	5.2%
50th perc.*	5.1%	4.9%	4.9%	4.8%	4.8%	4.8%	4.7%	4.7%	4.7%	4.7%
25th perc.	4.1%	4.4%	4.5%	4.4%	4.4%	4.3%	4.3%	4.3%	4.3%	4.2%
5th perc.	2.6%	3.5%	3.8%	3.9%	3.8%	3.8%	3.7%	3.7%	3.7%	3.7%

^{*}Median

Real Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	5.6%	4.7%	4.5%	4.5%	4.4%	4.2%	4.2%	4.1%	3.9%	3.9%
75th perc.	3.9%	3.4%	3.3%	3.2%	3.2%	3.1%	3.1%	3.0%	2.9%	2.9%
50th perc.*	2.6%	2.4%	2.5%	2.4%	2.3%	2.4%	2.3%	2.3%	2.3%	2.3%
25th perc.	1.4%	1.5%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%
5th perc.	-0.6%	0.1%	0.3%	0.4%	0.5%	0.5%	0.6%	0.6%	0.6%	0.6%

^{*}Median

Withdrawals from returns in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	603.9	717.8	859.7	930.0	1,157.0	1,477.4	1,784.7	2,048.8	2,522.1	2,821.1
75th perc.	490.3	506.4	546.2	573.5	648.7	742.8	845.8	962.1	1,141.7	1,226.5
50th perc.*	416.4	384.4	399.7	385.5	424.0	437.0	477.5	510.6	561.3	577.5
25th perc.	336.1	274.0	274.8	242.9	245.1	223.8	221.8	196.2	199.5	181.2
5th perc.	211.2	126.6	113.7	92.2	46.9	19.7	0.0	0.0	0.0	0.0

^{*}Median

Additional Withdrawals in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	798.0	1,486.7	1,950.4	2,311.7	2,454.2	2,640.3	2,893.1	3,086.0	3,518.0	3,787.4
75th perc.	0.0	0.0	0.0	138.0	66.0	169.1	201.1	302.1	399.8	345.3
50th perc.*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Total Withdrawals in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1,206.8	1,854.8	2,286.5	2,651.8	2,739.1	2,915.5	3,192.9	3,669.9	4,053.9	4,361.9
75th perc.	544.5	661.4	800.0	896.2	1,028.0	1,205.3	1,451.5	1,583.9	1,880.1	2,091.8
50th perc.*	441.4	443.2	504.1	531.1	590.2	675.4	758.7	858.7	1,016.0	1,053.0
25th perc.	350.7	317.5	329.4	332.9	371.2	365.1	401.6	444.4	489.4	488.1
5th perc.	220.3	149.5	155.5	136.4	130.4	117.4	96.8	87.8	86.5	50.8

^{*}Median

Total Contributions in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1,570.2	2,335.8	2,909.0	4,592.3	5,406.8	6,366.4	7,525.6	8,634.4	9,575.6	11,309.8
75th perc.	548.3	868.8	1,111.0	2,306.2	2,639.5	3,027.0	3,288.7	3,792.7	4,177.6	4,839.2
50th perc.*	0.0	0.0	0.0	794.9	977.2	974.8	955.3	1,151.4	1,285.5	1,603.9
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Efficient Mix Portfolio (Same Risk as Current Portfolio)

Nominal Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	9,677.7	11,663.1	14,121.9	18,290.6	23,285.1	28,603.3	34,904.1	42,168.0	50,769.4	61,169.8
75th perc.	8,650.4	9,439.3	10,532.5	12,566.6	14,968.4	17,822.9	20,784.2	24,347.3	28,006.1	32,296.4
50th perc.*	8,109.0	8,385.3	8,677.5	9,563.0	10,628.4	11,752.7	12,835.6	14,180.9	15,505.6	17,461.3
25th perc.	8,109.0	7,981.3	7,674.5	7,398.4	7,160.5	7,031.4	6,613.0	6,429.1	6,159.8	6,366.3
5th perc.	7,310.2	6,129.0	4,618.4	2,808.5	1,319.4	0.0	0.0	0.0	0.0	0.0

^{*}Median

Real Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	9,379.7	10,954.1	12,968.8	15,701.5	19,646.2	23,491.1	28,194.3	33,610.6	38,922.2	44,745.3
75th perc.	8,419.1	8,996.8	9,743.6	10,905.8	12,797.5	14,988.9	16,991.4	19,505.2	22,036.1	24,622.3
50th perc.*	7,998.8	8,011.0	8,080.8	8,441.2	9,139.7	9,883.2	10,522.7	11,347.1	12,364.0	13,436.4
25th perc.	7,876.6	7,582.6	7,180.3	6,715.0	6,405.3	6,036.9	5,504.9	5,315.6	4,884.0	4,866.4
5th perc.	7,177.6	5,965.6	4,369.8	2,581.8	1,213.7	0.0	0.0	0.0	0.0	0.0

^{*}Median

Nominal Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	8.8%	7.6%	7.1%	7.0%	6.9%	6.9%	6.8%	6.7%	6.6%	6.6%
75th perc.	6.7%	6.2%	6.1%	5.9%	5.8%	5.8%	5.8%	5.7%	5.7%	5.7%
50th perc.*	5.5%	5.4%	5.4%	5.3%	5.3%	5.2%	5.2%	5.1%	5.2%	5.1%
25th perc.	4.3%	4.6%	4.7%	4.7%	4.7%	4.7%	4.7%	4.7%	4.7%	4.7%
5th perc.	2.8%	3.5%	3.8%	3.9%	4.0%	4.0%	4.0%	4.0%	4.0%	4.1%

^{*}Median

Real Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	6.6%	5.4%	5.1%	5.0%	4.7%	4.7%	4.5%	4.4%	4.3%	4.2%
75th perc.	4.5%	4.0%	3.8%	3.7%	3.6%	3.5%	3.5%	3.4%	3.3%	3.3%
50th perc.*	3.0%	2.9%	2.9%	2.9%	2.8%	2.8%	2.7%	2.7%	2.7%	2.7%
25th perc.	1.7%	1.9%	2.0%	2.0%	2.0%	2.1%	2.1%	2.1%	2.1%	2.1%
5th perc.	-0.3%	0.5%	0.8%	0.9%	0.9%	1.0%	1.1%	1.0%	1.1%	1.2%

^{*}Median

Withdrawals from returns in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	714.3	785.7	923.7	1,015.7	1,294.0	1,521.4	1,931.6	2,212.7	2,776.0	3,029.0
75th perc.	546.8	554.7	610.2	624.2	715.9	827.4	932.4	1,089.3	1,206.2	1,412.7
50th perc.*	449.3	422.2	437.8	433.6	469.0	481.7	518.1	570.7	625.1	659.9
25th perc.	347.2	303.0	304.3	276.2	275.9	250.9	232.9	229.8	221.0	224.6
5th perc.	225.9	156.5	131.0	100.8	60.8	23.1	0.0	0.0	0.0	0.0

^{*}Median

Additional Withdrawals in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	798.0	1,486.7	1,950.4	2,311.7	2,454.2	2,640.3	2,893.1	3,086.0	3,518.0	3,787.4
75th perc.	0.0	0.0	0.0	138.0	66.0	169.1	201.1	302.1	399.8	345.3
50th perc.*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Total Withdrawals in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1,212.0	1,839.5	2,323.7	2,644.7	2,697.7	2,922.3	3,211.2	3,659.1	4,001.5	4,524.9
75th perc.	617.7	723.3	866.4	960.7	1,124.6	1,292.9	1,547.7	1,696.2	2,043.7	2,304.8
50th perc.*	481.3	498.4	561.7	581.1	658.9	751.4	837.5	960.6	1,045.9	1,193.1
25th perc.	370.5	358.2	368.2	384.5	414.3	429.5	444.4	484.8	554.0	565.6
5th perc.	237.4	199.9	186.1	167.4	155.2	156.0	114.8	108.9	105.4	64.4

^{*}Median

Total Contributions in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1,570.2	2,335.8	2,909.0	4,592.3	5,406.8	6,366.4	7,525.6	8,634.4	9,575.6	11,309.8
75th perc.	548.3	868.8	1,111.0	2,306.2	2,639.5	3,027.0	3,288.7	3,792.7	4,177.6	4,839.2
50th perc.*	0.0	0.0	0.0	794.9	977.2	974.8	955.3	1,151.4	1,285.5	1,603.9
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Portfolio A

Nominal Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	9,673.5	11,663.1	14,113.8	18,268.1	23,269.9	28,590.5	34,705.2	41,979.8	50,763.7	60,972.9
75th perc.	8,645.3	9,437.4	10,519.3	12,564.3	14,871.6	17,673.5	20,698.1	24,213.6	27,733.7	32,009.7
50th perc.*	8,109.0	8,370.7	8,646.5	9,525.3	10,567.7	11,713.7	12,764.3	14,040.9	15,419.2	17,251.7
25th perc.	8,109.0	7,931.0	7,630.6	7,361.0	7,072.0	6,943.5	6,583.3	6,291.6	6,065.0	6,259.6
5th perc.	7,308.4	6,106.4	4,578.5	2,790.3	1,311.1	0.0	0.0	0.0	0.0	0.0

^{*}Median

Real Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	9,370.6	10,954.1	12,943.4	15,686.2	19,565.1	23,491.1	28,022.1	33,438.1	38,804.7	44,565.1
75th perc.	8,417.9	8,980.8	9,718.5	10,895.0	12,749.2	14,858.2	16,844.7	19,505.2	21,772.4	24,537.9
50th perc.*	7,994.6	7,996.0	8,045.7	8,389.1	9,084.9	9,810.3	10,458.3	11,222.2	12,198.6	13,350.7
25th perc.	7,871.9	7,557.6	7,132.2	6,688.4	6,361.4	6,007.4	5,468.7	5,206.9	4,732.8	4,743.6
5th perc.	7,151.3	5,936.7	4,359.4	2,577.6	1,190.3	0.0	0.0	0.0	0.0	0.0

^{*}Median

Nominal Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	14.2%	11.6%	10.2%	9.4%	9.2%	8.8%	8.5%	8.3%	8.2%	8.1%
75th perc.	9.5%	8.2%	7.9%	7.6%	7.3%	7.2%	7.1%	7.0%	7.0%	7.0%
50th perc.*	6.6%	6.4%	6.4%	6.3%	6.3%	6.3%	6.3%	6.2%	6.2%	6.1%
25th perc.	3.7%	4.5%	5.0%	5.1%	5.3%	5.3%	5.4%	5.4%	5.4%	5.4%
5th perc.	0.0%	1.8%	2.9%	3.5%	3.8%	4.1%	4.2%	4.3%	4.4%	4.4%

^{*}Median

Real Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	11.4%	8.7%	7.6%	6.8%	6.4%	6.1%	5.9%	5.7%	5.5%	5.4%
75th perc.	6.8%	5.7%	5.4%	5.0%	4.9%	4.8%	4.6%	4.5%	4.4%	4.3%
50th perc.*	4.1%	3.9%	3.9%	3.8%	3.8%	3.8%	3.8%	3.7%	3.7%	3.6%
25th perc.	1.2%	2.0%	2.5%	2.6%	2.8%	2.9%	2.9%	2.9%	2.9%	2.9%
5th perc.	-2.4%	-0.7%	0.5%	1.0%	1.4%	1.6%	1.8%	1.8%	1.9%	2.0%

^{*}Median

Withdrawals from returns in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1,149.3	1,216.6	1,412.1	1,507.8	1,961.9	2,221.5	2,842.8	3,196.3	4,096.4	4,490.9
75th perc.	772.2	773.7	845.2	843.2	956.8	1,090.4	1,229.3	1,403.0	1,483.2	1,831.4
50th perc.*	532.7	493.4	521.3	496.4	551.8	554.2	551.6	578.9	630.5	697.6
25th perc.	301.4	251.1	275.1	224.8	221.3	197.7	158.4	137.8	112.9	85.7
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Additional Withdrawals in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	798.0	1,486.7	1,950.4	2,311.7	2,454.2	2,640.3	2,893.1	3,086.0	3,518.0	3,787.4
75th perc.	0.0	0.0	0.0	138.0	66.0	169.1	201.1	302.1	399.8	345.3
50th perc.*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Total Withdrawals in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1,496.1	1,955.0	2,456.2	2,731.7	2,897.6	3,358.3	3,751.4	4,290.2	4,829.9	5,342.8
75th perc.	864.6	993.2	1,160.1	1,260.1	1,421.4	1,641.9	1,896.1	2,094.8	2,464.7	2,652.4
50th perc.*	598.3	614.1	709.3	725.2	834.5	897.0	999.6	1,116.2	1,211.8	1,388.3
25th perc.	345.8	352.0	387.7	385.8	413.0	407.3	413.5	458.1	498.0	525.0
5th perc.	46.5	20.9	7.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Total Contributions in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1,570.2	2,335.8	2,909.0	4,592.3	5,406.8	6,366.4	7,525.6	8,634.4	9,575.6	11,309.8
75th perc.	548.3	868.8	1,111.0	2,306.2	2,639.5	3,027.0	3,288.7	3,792.7	4,177.6	4,839.2
50th perc.*	0.0	0.0	0.0	794.9	977.2	974.8	955.3	1,151.4	1,285.5	1,603.9
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Portfolio B

Nominal Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	9,673.5	11,663.1	14,064.2	18,212.3	23,218.7	28,478.8	34,705.2	41,932.1	50,700.5	60,923.2
75th perc.	8,639.9	9,435.0	10,517.0	12,531.5	14,871.6	17,641.7	20,614.4	24,166.7	27,577.0	31,891.2
50th perc.*	8,109.0	8,358.6	8,642.5	9,519.5	10,541.9	11,680.5	12,678.1	13,943.1	15,360.1	17,158.9
25th perc.	8,109.0	7,894.9	7,605.7	7,353.5	7,031.4	6,900.8	6,534.4	6,251.4	5,994.4	6,192.8
5th perc.	7,282.2	6,071.2	4,578.5	2,773.3	1,265.2	0.0	0.0	0.0	0.0	0.0

^{*}Median

Real Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	9,367.2	10,954.1	12,902.1	15,686.2	19,520.8	23,459.1	28,007.6	33,376.0	38,756.0	44,496.3
75th perc.	8,412.7	8,973.1	9,710.9	10,869.8	12,686.4	14,813.3	16,796.7	19,420.2	21,702.7	24,458.8
50th perc.*	7,993.6	7,990.7	8,039.3	8,371.0	9,036.7	9,765.7	10,424.1	11,134.1	12,128.1	13,259.3
25th perc.	7,865.6	7,531.8	7,111.1	6,668.0	6,319.3	5,934.4	5,457.0	5,181.4	4,714.0	4,669.0
5th perc.	7,142.1	5,895.1	4,320.3	2,538.0	1,165.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Nominal Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	15.4%	12.6%	11.1%	10.0%	9.7%	9.3%	9.0%	8.8%	8.6%	8.5%
75th perc.	10.1%	8.7%	8.2%	7.9%	7.7%	7.6%	7.4%	7.3%	7.3%	7.2%
50th perc.*	6.8%	6.5%	6.5%	6.5%	6.5%	6.4%	6.4%	6.4%	6.4%	6.4%
25th perc.	3.4%	4.4%	4.9%	5.1%	5.3%	5.4%	5.5%	5.5%	5.6%	5.6%
5th perc.	-0.8%	1.2%	2.6%	3.3%	3.7%	4.1%	4.1%	4.3%	4.4%	4.5%

^{*}Median

Real Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	12.6%	9.7%	8.4%	7.5%	7.0%	6.7%	6.4%	6.2%	6.1%	5.9%
75th perc.	7.4%	6.1%	5.7%	5.4%	5.2%	5.1%	4.9%	4.8%	4.7%	4.6%
50th perc.*	4.2%	4.1%	4.0%	4.0%	4.0%	4.0%	3.9%	3.9%	3.9%	3.8%
25th perc.	0.9%	1.8%	2.5%	2.6%	2.8%	2.9%	3.0%	3.0%	3.0%	3.0%
5th perc.	-3.4%	-1.2%	0.2%	0.7%	1.1%	1.4%	1.6%	1.7%	1.9%	2.0%

^{*}Median

Withdrawals from returns in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1,249.4	1,347.9	1,545.9	1,661.1	2,146.4	2,406.9	3,095.1	3,520.1	4,489.8	4,799.6
75th perc.	821.8	821.4	903.1	903.6	1,019.3	1,157.8	1,287.4	1,468.5	1,560.1	1,907.4
50th perc.*	548.6	504.7	535.6	503.5	561.3	556.8	546.9	581.7	625.5	710.7
25th perc.	273.7	227.1	251.5	199.6	187.3	175.4	114.8	106.9	82.0	57.8
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Additional Withdrawals in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	798.0	1,486.7	1,950.4	2,311.7	2,454.2	2,640.3	2,893.1	3,086.0	3,518.0	3,787.4
75th perc.	0.0	0.0	0.0	138.0	66.0	169.1	201.1	302.1	399.8	345.3
50th perc.*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Total Withdrawals in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1,596.4	2,013.1	2,506.6	2,793.0	2,977.5	3,475.6	3,966.2	4,416.2	5,139.5	5,553.1
75th perc.	918.4	1,057.5	1,231.0	1,339.8	1,502.9	1,735.7	2,004.9	2,202.9	2,590.5	2,772.9
50th perc.*	611.3	636.1	742.7	757.9	865.0	943.2	1,035.2	1,154.5	1,268.6	1,428.9
25th perc.	330.2	337.7	380.7	381.9	401.9	413.9	382.5	448.2	474.8	515.1
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Total Contributions in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1,570.2	2,335.8	2,909.0	4,592.3	5,406.8	6,366.4	7,525.6	8,634.4	9,575.6	11,309.8
75th perc.	548.3	868.8	1,111.0	2,306.2	2,639.5	3,027.0	3,288.7	3,792.7	4,177.6	4,839.2
50th perc.*	0.0	0.0	0.0	794.9	977.2	974.8	955.3	1,151.4	1,285.5	1,603.9
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Portfolio C

Nominal Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	9,662.4	11,661.4	14,051.3	18,151.2	23,188.5	28,319.6	34,628.2	41,884.8	50,524.0	60,676.7
75th perc.	8,638.3	9,412.0	10,502.0	12,475.7	14,845.4	17,607.3	20,520.2	24,053.4	27,384.5	31,655.3
50th perc.*	8,109.0	8,349.0	8,610.1	9,498.5	10,507.6	11,591.5	12,574.5	13,905.6	15,256.8	17,040.9
25th perc.	8,109.0	7,847.9	7,550.3	7,309.1	6,985.9	6,838.3	6,457.6	6,157.9	5,863.5	6,039.7
5th perc.	7,282.2	6,039.8	4,531.5	2,763.5	1,215.6	0.0	0.0	0.0	0.0	0.0

^{*}Median

Real Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	9,367.2	10,954.1	12,855.7	15,653.2	19,478.8	23,311.3	27,981.5	33,302.6	38,601.8	44,435.2
75th perc.	8,404.2	8,966.0	9,680.7	10,839.7	12,608.8	14,761.4	16,660.3	19,342.6	21,540.5	24,352.2
50th perc.*	7,990.0	7,974.7	8,020.4	8,312.5	8,968.4	9,733.4	10,312.0	11,086.2	12,067.0	13,116.9
25th perc.	7,858.4	7,489.2	7,063.6	6,618.5	6,256.8	5,851.9	5,411.3	5,149.4	4,633.2	4,608.5
5th perc.	7,113.0	5,835.4	4,298.1	2,489.8	1,154.2	0.0	0.0	0.0	0.0	0.0

^{*}Median

Nominal Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	17.1%	13.7%	12.1%	10.8%	10.4%	10.0%	9.5%	9.3%	9.1%	9.0%
75th perc.	10.8%	9.2%	8.7%	8.3%	8.1%	8.0%	7.8%	7.7%	7.6%	7.5%
50th perc.*	6.9%	6.6%	6.7%	6.6%	6.7%	6.6%	6.7%	6.6%	6.6%	6.5%
25th perc.	3.0%	4.1%	4.8%	5.1%	5.4%	5.4%	5.6%	5.6%	5.7%	5.7%
5th perc.	-1.9%	0.4%	2.1%	3.0%	3.4%	3.9%	4.0%	4.1%	4.3%	4.5%

^{*}Median

Real Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	14.2%	10.9%	9.4%	8.3%	7.8%	7.3%	7.0%	6.8%	6.6%	6.5%
75th perc.	8.1%	6.7%	6.2%	5.8%	5.6%	5.5%	5.2%	5.2%	5.0%	4.9%
50th perc.*	4.3%	4.1%	4.2%	4.2%	4.2%	4.2%	4.1%	4.0%	4.1%	4.1%
25th perc.	0.6%	1.6%	2.4%	2.5%	2.8%	3.0%	3.0%	3.0%	3.1%	3.1%
5th perc.	-4.3%	-1.9%	-0.3%	0.4%	0.8%	1.2%	1.5%	1.6%	1.8%	1.9%

^{*}Median

Withdrawals from returns in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1,385.5	1,512.1	1,702.2	1,854.5	2,341.8	2,661.4	3,381.3	3,773.8	4,888.0	5,244.4
75th perc.	874.4	877.9	959.9	954.5	1,094.8	1,245.2	1,349.5	1,559.5	1,645.6	1,991.2
50th perc.*	559.9	514.0	554.3	520.9	575.0	568.6	561.5	583.6	612.2	705.2
25th perc.	242.5	192.8	231.1	164.7	161.6	135.2	74.4	67.4	41.2	17.5
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Additional Withdrawals in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	798.0	1,486.7	1,950.4	2,311.7	2,454.2	2,640.3	2,893.1	3,086.0	3,518.0	3,787.4
75th perc.	0.0	0.0	0.0	138.0	66.0	169.1	201.1	302.1	399.8	345.3
50th perc.*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Total Withdrawals in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1,703.1	2,073.1	2,592.1	2,870.7	3,119.1	3,630.2	4,160.8	4,669.9	5,499.4	5,907.2
75th perc.	973.4	1,137.5	1,320.9	1,435.6	1,599.2	1,827.5	2,110.2	2,282.2	2,723.4	2,908.7
50th perc.*	625.9	660.5	779.9	809.5	916.0	975.6	1,061.2	1,196.5	1,312.0	1,454.7
25th perc.	310.6	318.0	368.4	361.9	375.4	408.5	362.0	433.4	451.5	505.5
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Total Contributions in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1,570.2	2,335.8	2,909.0	4,592.3	5,406.8	6,366.4	7,525.6	8,634.4	9,575.6	11,309.8
75th perc.	548.3	868.8	1,111.0	2,306.2	2,639.5	3,027.0	3,288.7	3,792.7	4,177.6	4,839.2
50th perc.*	0.0	0.0	0.0	794.9	977.2	974.8	955.3	1,151.4	1,285.5	1,603.9
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Portfolio D (Recommendation)

Nominal Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	9,662.4	11,640.2	14,029.4	18,080.0	23,054.5	28,114.9	34,547.0	41,814.1	50,369.0	60,402.6
75th perc.	8,633.3	9,392.9	10,454.8	12,407.5	14,788.5	17,556.1	20,424.3	23,905.5	27,156.0	31,215.9
50th perc.*	8,109.0	8,313.5	8,555.5	9,417.7	10,431.7	11,477.6	12,428.2	13,806.4	15,102.6	16,865.8
25th perc.	8,109.0	7,794.9	7,499.7	7,251.1	6,911.6	6,759.0	6,367.6	6,078.8	5,754.3	5,859.5
5th perc.	7,224.2	6,022.7	4,448.2	2,660.9	1,184.9	0.0	0.0	0.0	0.0	0.0

^{*}Median

Real Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	9,363.7	10,939.6	12,802.9	15,636.0	19,403.9	23,275.6	27,950.3	33,030.3	38,235.8	44,291.4
75th perc.	8,400.9	8,951.1	9,641.3	10,787.3	12,575.2	14,702.6	16,524.0	19,244.5	21,409.7	24,012.7
50th perc.*	7,986.8	7,957.6	7,989.0	8,275.3	8,917.5	9,627.8	10,222.7	11,053.7	11,950.0	13,000.0
25th perc.	7,848.0	7,447.0	6,997.2	6,566.8	6,185.6	5,795.7	5,340.4	5,079.1	4,545.2	4,519.4
5th perc.	7,089.5	5,794.9	4,206.1	2,453.8	1,112.6	0.0	0.0	0.0	0.0	0.0

^{*}Median

Nominal Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	18.7%	14.8%	13.1%	11.7%	11.2%	10.7%	10.2%	9.9%	9.7%	9.5%
75th perc.	11.5%	9.8%	9.1%	8.8%	8.5%	8.4%	8.2%	8.1%	7.9%	7.9%
50th perc.*	7.0%	6.7%	6.9%	6.8%	6.9%	6.9%	6.9%	6.8%	6.8%	6.8%
25th perc.	2.7%	3.9%	4.7%	5.0%	5.4%	5.5%	5.6%	5.7%	5.8%	5.8%
5th perc.	-3.1%	-0.4%	1.6%	2.6%	3.1%	3.7%	3.9%	4.0%	4.2%	4.5%

^{*}Median

Real Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	16.0%	12.3%	10.4%	9.2%	8.5%	8.0%	7.6%	7.4%	7.2%	7.0%
75th perc.	8.8%	7.1%	6.6%	6.3%	6.0%	5.9%	5.6%	5.6%	5.4%	5.3%
50th perc.*	4.5%	4.3%	4.4%	4.4%	4.4%	4.4%	4.3%	4.2%	4.3%	4.3%
25th perc.	0.1%	1.3%	2.2%	2.4%	2.8%	3.0%	3.1%	3.1%	3.1%	3.2%
5th perc.	-5.5%	-2.7%	-0.8%	-0.1%	0.5%	1.0%	1.3%	1.4%	1.7%	1.9%

^{*}Median

Withdrawals from returns in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1,515.1	1,643.9	1,865.9	2,008.4	2,520.9	2,874.2	3,675.8	4,115.2	5,318.1	5,729.4
75th perc.	935.6	928.7	1,031.9	1,033.3	1,174.9	1,325.3	1,424.4	1,645.3	1,735.7	2,100.2
50th perc.*	570.0	524.1	574.8	536.0	593.9	561.9	564.2	585.6	606.7	711.9
25th perc.	215.1	154.8	209.5	131.8	129.6	110.8	41.5	29.5	4.9	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Additional Withdrawals in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	798.0	1,486.7	1,950.4	2,311.7	2,454.2	2,640.3	2,893.1	3,086.0	3,518.0	3,787.4
75th perc.	0.0	0.0	0.0	138.0	66.0	169.1	201.1	302.1	399.8	345.3
50th perc.*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Total Withdrawals in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1,811.8	2,139.6	2,656.5	2,969.3	3,291.2	3,755.2	4,414.1	4,995.4	5,842.6	6,229.4
75th perc.	1,034.7	1,218.0	1,402.2	1,524.3	1,673.4	1,907.7	2,184.1	2,391.0	2,827.4	3,018.0
50th perc.*	645.4	682.4	821.9	841.6	965.5	1,025.0	1,094.2	1,230.9	1,343.2	1,522.5
25th perc.	284.0	294.9	352.9	345.7	359.1	408.0	339.0	415.5	427.8	488.5
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Total Contributions in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1,570.2	2,335.8	2,909.0	4,592.3	5,406.8	6,366.4	7,525.6	8,634.4	9,575.6	11,309.8
75th perc.	548.3	868.8	1,111.0	2,306.2	2,639.5	3,027.0	3,288.7	3,792.7	4,177.6	4,839.2
50th perc.*	0.0	0.0	0.0	794.9	977.2	974.8	955.3	1,151.4	1,285.5	1,603.9
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Portfolio E

Nominal Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	9,646.4	11,625.0	14,008.0	17,993.4	22,875.6	27,973.0	34,446.5	41,708.4	50,132.0	60,062.0
75th perc.	8,624.5	9,370.3	10,422.8	12,346.9	14,711.7	17,451.7	20,352.5	23,757.7	26,971.0	30,962.4
50th perc.*	8,109.0	8,269.4	8,521.5	9,372.5	10,346.3	11,403.4	12,259.8	13,669.6	14,946.2	16,643.7
25th perc.	8,109.0	7,746.6	7,444.6	7,182.0	6,828.0	6,677.4	6,287.8	5,946.9	5,625.7	5,723.5
5th perc.	7,170.1	6,016.3	4,367.6	2,593.6	1,114.8	0.0	0.0	0.0	0.0	0.0

^{*}Median

Real Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	9,339.1	10,902.7	12,783.4	15,586.6	19,276.4	23,141.9	27,828.4	32,890.0	38,075.2	44,087.6
75th perc.	8,384.7	8,923.4	9,603.0	10,750.2	12,536.6	14,609.0	16,482.1	19,078.3	21,214.0	23,798.2
50th perc.*	7,982.7	7,935.2	7,937.2	8,231.5	8,845.6	9,530.5	10,128.9	10,911.0	11,824.4	12,868.9
25th perc.	7,836.9	7,400.5	6,909.2	6,488.4	6,066.7	5,693.7	5,261.6	4,969.2	4,481.8	4,372.3
5th perc.	7,053.8	5,747.5	4,126.3	2,410.7	1,009.7	0.0	0.0	0.0	0.0	0.0

^{*}Median

Nominal Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	20.6%	16.1%	14.0%	12.6%	11.8%	11.3%	10.8%	10.5%	10.2%	10.0%
75th perc.	12.2%	10.4%	9.6%	9.2%	8.9%	8.8%	8.6%	8.4%	8.3%	8.2%
50th perc.*	7.1%	6.9%	7.1%	7.0%	7.1%	7.1%	7.1%	7.0%	7.0%	7.0%
25th perc.	2.3%	3.7%	4.6%	5.0%	5.3%	5.5%	5.6%	5.7%	5.8%	5.9%
5th perc.	-4.2%	-1.2%	1.1%	2.1%	2.9%	3.5%	3.7%	3.9%	4.1%	4.4%

^{*}Median

Real Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	17.7%	13.5%	11.3%	9.9%	9.3%	8.7%	8.3%	8.0%	7.7%	7.5%
75th perc.	9.6%	7.7%	7.1%	6.7%	6.4%	6.2%	6.0%	5.9%	5.7%	5.6%
50th perc.*	4.6%	4.4%	4.5%	4.6%	4.6%	4.6%	4.5%	4.5%	4.5%	4.5%
25th perc.	-0.3%	1.1%	2.2%	2.4%	2.8%	3.0%	3.1%	3.1%	3.2%	3.3%
5th perc.	-6.7%	-3.4%	-1.4%	-0.4%	0.3%	0.7%	1.1%	1.3%	1.6%	1.8%

^{*}Median

Withdrawals from returns in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1,666.7	1,790.2	2,011.0	2,179.2	2,703.0	3,095.5	3,913.6	4,478.1	5,762.1	6,178.1
75th perc.	988.9	987.8	1,095.6	1,102.6	1,244.6	1,384.1	1,508.2	1,739.9	1,832.5	2,169.5
50th perc.*	575.6	535.7	591.3	552.0	585.0	575.0	566.4	588.5	618.1	712.4
25th perc.	183.2	119.5	182.4	102.5	100.5	81.0	6.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Additional Withdrawals in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	798.0	1,486.7	1,950.4	2,311.7	2,454.2	2,640.3	2,893.1	3,086.0	3,518.0	3,787.4
75th perc.	0.0	0.0	0.0	138.0	66.0	169.1	201.1	302.1	399.8	345.3
50th perc.*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Total Withdrawals in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1,940.6	2,243.8	2,810.4	3,065.5	3,443.7	3,875.2	4,623.2	5,220.1	6,095.4	6,718.5
75th perc.	1,112.7	1,295.5	1,477.3	1,599.9	1,782.8	2,004.9	2,270.2	2,491.9	2,875.2	3,150.2
50th perc.*	661.1	716.4	860.3	882.5	999.3	1,052.2	1,123.7	1,250.4	1,378.4	1,547.8
25th perc.	262.7	277.2	341.8	330.8	341.1	385.5	318.8	395.0	403.0	464.1
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Total Contributions in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1,570.2	2,335.8	2,909.0	4,592.3	5,406.8	6,366.4	7,525.6	8,634.4	9,575.6	11,309.8
75th perc.	548.3	868.8	1,111.0	2,306.2	2,639.5	3,027.0	3,288.7	3,792.7	4,177.6	4,839.2
50th perc.*	0.0	0.0	0.0	794.9	977.2	974.8	955.3	1,151.4	1,285.5	1,603.9
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

FUND Y

Current Portfolio

Nominal Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	2,309.3	3,295.5	4,427.1	5,709.4	7,233.6	8,981.5	11,000.2	13,350.7	16,082.8	19,086.6
75th perc.	2,188.2	3,099.5	4,142.9	5,302.7	6,631.8	8,109.0	9,795.6	11,679.5	13,781.8	16,087.0
50th perc.*	2,113.1	2,950.1	3,878.4	4,856.8	5,984.3	7,172.1	8,506.9	9,930.8	11,550.7	13,385.9
25th perc.	1,988.9	2,577.9	3,268.9	4,028.3	4,865.5	5,776.7	6,722.5	7,802.1	8,972.4	10,324.0
5th perc.	1,686.1	2,084.8	2,534.8	3,036.0	3,581.3	4,153.2	4,782.4	5,343.6	5,892.2	6,674.3

^{*}Median

Real Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	2,254.4	3,149.4	4,117.6	5,177.4	6,395.3	7,786.7	9,250.6	11,029.9	12,803.1	15,004.7
75th perc.	2,136.7	2,943.2	3,827.6	4,776.2	5,817.4	6,952.3	8,151.7	9,514.0	10,960.8	12,570.1
50th perc.*	2,058.9	2,789.6	3,583.7	4,398.8	5,260.1	6,168.6	7,127.8	8,162.9	9,213.7	10,399.6
25th perc.	1,938.4	2,469.5	3,039.0	3,683.8	4,335.0	5,016.8	5,751.1	6,545.0	7,298.1	8,180.0
5th perc.	1,657.3	2,017.1	2,403.7	2,841.5	3,260.1	3,703.2	4,123.7	4,538.7	4,938.8	5,366.6

^{*}Median

Nominal Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	7.4%	6.1%	6.0%	6.1%	6.1%	6.2%	6.2%	6.2%	6.1%	6.2%
75th perc.	6.0%	5.5%	5.3%	5.3%	5.3%	5.3%	5.3%	5.2%	5.2%	5.2%
50th perc.*	5.1%	4.9%	4.9%	4.8%	4.8%	4.7%	4.7%	4.7%	4.7%	4.7%
25th perc.	4.2%	4.4%	4.5%	4.4%	4.4%	4.3%	4.3%	4.2%	4.3%	4.2%
5th perc.	2.6%	3.5%	3.9%	3.9%	3.8%	3.7%	3.7%	3.7%	3.7%	3.6%

^{*}Median

Real Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	5.6%	4.7%	4.5%	4.5%	4.4%	4.2%	4.2%	4.1%	3.9%	3.9%
75th perc.	3.9%	3.4%	3.3%	3.2%	3.1%	3.1%	3.1%	3.0%	2.9%	2.9%
50th perc.*	2.6%	2.4%	2.5%	2.4%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%
25th perc.	1.4%	1.5%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%
5th perc.	-0.5%	0.1%	0.3%	0.4%	0.5%	0.5%	0.6%	0.6%	0.6%	0.6%

^{*}Median

Total Contributions in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	895.9	963.2	1,068.7	1,176.3	1,322.0	1,492.3	1,694.0	1,916.3	2,190.1	2,489.9
75th perc.	772.6	833.8	909.8	995.5	1,110.6	1,215.3	1,338.1	1,478.1	1,630.2	1,812.6
50th perc.*	699.6	747.7	806.9	878.0	952.8	1,011.6	1,081.5	1,187.7	1,265.7	1,386.3
25th perc.	577.0	416.2	410.0	404.2	441.5	462.8	501.5	542.2	571.3	656.5
5th perc.	276.8	280.9	295.3	306.7	317.3	328.9	342.7	347.2	364.3	370.6

^{*}Median

Portfolio A [Recommendation 1 (Maintains Policy)]

Nominal Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	2,405.4	3,529.1	4,842.5	6,366.0	8,202.1	10,380.5	12,735.2	15,692.6	19,068.0	23,103.9
75th perc.	2,250.4	3,222.4	4,362.5	5,640.3	7,149.8	8,880.5	10,801.9	13,012.8	15,572.3	18,381.4
50th perc.*	2,136.2	2,987.2	3,973.8	5,062.4	6,288.7	7,638.0	9,106.3	10,789.7	12,664.5	14,702.9
25th perc.	1,969.4	2,610.1	3,350.8	4,161.7	5,088.1	6,064.6	7,186.5	8,240.7	9,688.9	11,060.4
5th perc.	1,658.5	2,068.1	2,568.1	3,073.3	3,629.4	4,215.9	4,826.9	5,375.8	6,077.8	6,748.2

^{*}Median

Real Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	2,340.4	3,350.9	4,476.3	5,740.9	7,197.6	8,860.1	10,718.4	12,921.6	15,106.0	17,920.9
75th perc.	2,194.4	3,061.1	4,047.2	5,081.2	6,287.1	7,595.8	9,087.0	10,656.7	12,343.5	14,254.4
50th perc.*	2,078.9	2,843.6	3,693.0	4,564.1	5,548.2	6,586.6	7,670.7	8,869.6	10,178.1	11,571.9
25th perc.	1,928.1	2,499.0	3,149.5	3,794.9	4,538.0	5,286.4	6,127.2	6,932.9	7,839.4	8,914.0
5th perc.	1,628.6	2,004.0	2,426.2	2,868.6	3,321.6	3,740.9	4,193.0	4,566.4	5,028.1	5,579.9

^{*}Median

Nominal Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	20.0%	15.5%	13.7%	12.2%	11.6%	11.0%	10.4%	10.2%	10.0%	9.8%
75th perc.	12.1%	10.1%	9.5%	9.0%	8.7%	8.6%	8.3%	8.2%	8.1%	8.0%
50th perc.*	7.4%	6.8%	7.0%	6.9%	7.0%	6.9%	6.9%	6.8%	6.8%	6.8%
25th perc.	2.4%	3.8%	4.6%	4.9%	5.3%	5.4%	5.5%	5.5%	5.7%	5.7%
5th perc.	-3.7%	-0.7%	1.2%	2.2%	2.8%	3.4%	3.6%	3.8%	4.0%	4.2%

^{*}Median

Real Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	17.0%	12.9%	10.9%	9.6%	8.8%	8.4%	7.9%	7.6%	7.4%	7.1%
75th perc.	9.4%	7.5%	6.9%	6.5%	6.2%	6.0%	5.7%	5.7%	5.5%	5.4%
50th perc.*	4.7%	4.4%	4.5%	4.5%	4.5%	4.5%	4.4%	4.3%	4.4%	4.3%
25th perc.	0.0%	1.2%	2.2%	2.5%	2.8%	2.9%	3.1%	3.0%	3.1%	3.2%
5th perc.	-6.2%	-3.0%	-1.1%	-0.3%	0.3%	0.8%	1.1%	1.4%	1.5%	1.8%

^{*}Median

Total Contributions in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	895.9	963.2	1,068.7	1,176.3	1,322.0	1,492.3	1,694.0	1,916.3	2,190.1	2,489.9
75th perc.	772.6	833.8	909.8	995.5	1,110.6	1,215.3	1,338.1	1,478.1	1,630.2	1,812.6
50th perc.*	699.6	747.7	806.9	878.0	952.8	1,011.6	1,081.5	1,187.7	1,265.7	1,386.3
25th perc.	577.0	416.2	410.0	404.2	441.5	462.8	501.5	542.2	571.3	656.5
5th perc.	276.8	280.9	295.3	306.7	317.3	328.9	342.7	347.2	364.3	370.6

^{*}Median

Portfolio B

Nominal Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	2,388.1	3,498.3	4,788.0	6,285.8	8,120.2	10,244.1	12,579.5	15,471.6	18,786.6	22,636.5
75th perc.	2,242.7	3,209.8	4,347.0	5,608.5	7,125.4	8,829.8	10,729.9	12,937.1	15,475.5	18,251.6
50th perc.*	2,135.0	2,989.4	3,978.9	5,065.0	6,294.4	7,634.5	9,093.2	10,808.2	12,681.7	14,797.4
25th perc.	1,976.7	2,607.7	3,355.3	4,190.6	5,082.1	6,075.3	7,188.7	8,250.3	9,655.7	11,205.4
5th perc.	1,666.0	2,077.4	2,584.7	3,099.5	3,650.5	4,233.6	4,867.8	5,452.3	6,160.4	6,817.0

^{*}Median

Real Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	2,331.6	3,324.8	4,451.5	5,699.0	7,154.0	8,773.3	10,641.3	12,741.1	15,142.2	17,825.8
75th perc.	2,188.1	3,052.1	4,029.8	5,071.9	6,273.7	7,568.5	8,995.0	10,552.5	12,290.6	14,169.3
50th perc.*	2,078.2	2,841.0	3,685.9	4,556.0	5,539.2	6,561.6	7,647.4	8,855.7	10,178.1	11,535.3
25th perc.	1,930.8	2,496.1	3,159.3	3,794.6	4,532.1	5,285.0	6,122.6	6,910.7	7,892.0	8,838.1
5th perc.	1,641.1	2,009.5	2,446.0	2,874.3	3,306.4	3,755.9	4,237.9	4,627.2	5,112.1	5,637.8

^{*}Median

Nominal Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	18.4%	14.7%	13.0%	11.6%	11.1%	10.6%	10.1%	9.9%	9.6%	9.4%
75th perc.	11.3%	9.7%	9.0%	8.8%	8.5%	8.4%	8.1%	8.0%	7.9%	7.9%
50th perc.*	6.9%	6.7%	7.0%	6.9%	6.9%	6.9%	6.8%	6.8%	6.8%	6.8%
25th perc.	2.8%	3.9%	4.7%	5.0%	5.4%	5.5%	5.6%	5.6%	5.7%	5.8%
5th perc.	-2.6%	-0.1%	1.8%	2.7%	3.2%	3.8%	4.0%	4.0%	4.2%	4.5%

^{*}Median

Real Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	15.7%	12.0%	10.2%	9.2%	8.5%	7.9%	7.7%	7.4%	7.3%	7.0%
75th perc.	8.6%	7.0%	6.6%	6.2%	6.0%	5.8%	5.6%	5.6%	5.4%	5.3%
50th perc.*	4.4%	4.2%	4.3%	4.4%	4.4%	4.4%	4.3%	4.3%	4.3%	4.3%
25th perc.	0.2%	1.4%	2.2%	2.5%	2.8%	3.0%	3.1%	3.0%	3.1%	3.2%
5th perc.	-5.2%	-2.4%	-0.7%	0.0%	0.6%	1.0%	1.2%	1.4%	1.6%	1.8%

^{*}Median

Total Contributions in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	895.9	963.2	1,068.7	1,176.3	1,322.0	1,492.3	1,694.0	1,916.3	2,190.1	2,489.9
75th perc.	772.6	833.8	909.8	995.5	1,110.6	1,215.3	1,338.1	1,478.1	1,630.2	1,812.6
50th perc.*	699.6	747.7	806.9	878.0	952.8	1,011.6	1,081.5	1,187.7	1,265.7	1,386.3
25th perc.	577.0	416.2	410.0	404.2	441.5	462.8	501.5	542.2	571.3	656.5
5th perc.	276.8	280.9	295.3	306.7	317.3	328.9	342.7	347.2	364.3	370.6

^{*}Median

Portfolio C

Nominal Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	2,459.2	3,661.6	5,047.2	6,636.5	8,631.2	10,997.4	13,628.6	16,933.2	20,507.3	24,845.9
75th perc.	2,269.3	3,270.7	4,438.0	5,761.0	7,354.9	9,160.3	11,157.7	13,509.2	16,231.1	19,333.5
50th perc.*	2,137.1	2,996.1	3,990.4	5,113.8	6,391.3	7,733.9	9,260.0	11,099.8	13,030.0	15,203.2
25th perc.	1,955.4	2,604.7	3,388.5	4,187.6	5,103.3	6,127.0	7,288.7	8,436.6	9,784.1	11,307.8
5th perc.	1,648.8	2,043.2	2,552.2	3,062.6	3,621.0	4,193.1	4,776.6	5,332.4	6,061.0	6,769.7

^{*}Median

Real Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	2,388.4	3,474.0	4,680.0	6,050.7	7,566.9	9,392.7	11,454.4	13,864.2	16,391.9	19,291.9
75th perc.	2,214.3	3,112.6	4,128.4	5,199.2	6,503.3	7,852.8	9,390.0	11,063.2	12,916.0	14,873.0
50th perc.*	2,082.0	2,847.8	3,705.3	4,598.5	5,615.4	6,680.5	7,815.3	9,092.9	10,385.0	11,891.0
25th perc.	1,909.8	2,489.6	3,173.0	3,811.8	4,580.7	5,313.3	6,180.1	6,946.2	7,965.6	9,022.0
5th perc.	1,617.4	1,975.4	2,417.3	2,822.4	3,281.4	3,712.7	4,134.7	4,482.3	4,965.7	5,444.9

^{*}Median

Nominal Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	25.7%	19.3%	16.9%	14.8%	13.8%	13.1%	12.5%	12.1%	11.7%	11.4%
75th perc.	14.0%	11.9%	10.9%	10.4%	10.0%	9.8%	9.5%	9.3%	9.2%	9.1%
50th perc.*	7.5%	7.3%	7.6%	7.6%	7.6%	7.6%	7.5%	7.4%	7.4%	7.4%
25th perc.	1.6%	3.2%	4.3%	4.8%	5.3%	5.4%	5.6%	5.7%	5.8%	5.9%
5th perc.	-6.6%	-2.6%	-0.1%	1.1%	2.0%	2.7%	3.1%	3.4%	3.7%	4.0%

^{*}Median

Real Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	22.5%	16.4%	14.1%	12.2%	11.1%	10.4%	9.9%	9.5%	9.1%	8.9%
75th perc.	11.3%	9.2%	8.3%	7.8%	7.4%	7.2%	6.9%	6.8%	6.6%	6.4%
50th perc.*	5.0%	4.8%	5.0%	5.0%	5.0%	5.1%	5.0%	4.9%	4.9%	4.9%
25th perc.	-0.9%	0.5%	1.9%	2.3%	2.7%	3.0%	3.1%	3.1%	3.3%	3.3%
5th perc.	-8.8%	-4.7%	-2.6%	-1.3%	-0.5%	0.1%	0.6%	0.9%	1.2%	1.5%

^{*}Median

Total Contributions in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	895.9	963.2	1,068.7	1,176.3	1,322.0	1,492.3	1,694.0	1,916.3	2,190.1	2,489.9
75th perc.	772.6	833.8	909.8	995.5	1,110.6	1,215.3	1,338.1	1,478.1	1,630.2	1,812.6
50th perc.*	699.6	747.7	806.9	878.0	952.8	1,011.6	1,081.5	1,187.7	1,265.7	1,386.3
25th perc.	577.0	416.2	410.0	404.2	441.5	462.8	501.5	542.2	571.3	656.5
5th perc.	276.8	280.9	295.3	306.7	317.3	328.9	342.7	347.2	364.3	370.6

^{*}Median

Portfolio D [Recommendation 2 (Relaxes Policy)]

Nominal Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	2,479.9	3,701.1	5,116.2	6,752.1	8,809.5	11,181.5	13,892.3	17,287.8	21,017.2	25,515.1
75th perc.	2,276.3	3,286.3	4,466.8	5,811.4	7,425.2	9,247.3	11,286.5	13,629.3	16,405.6	19,547.8
50th perc.*	2,138.8	2,996.0	3,998.2	5,119.7	6,415.4	7,756.0	9,265.6	11,145.3	13,097.8	15,317.5
25th perc.	1,950.9	2,606.9	3,388.3	4,192.3	5,109.3	6,124.5	7,296.5	8,457.9	9,827.3	11,383.7
5th perc.	1,642.7	2,031.6	2,534.9	3,042.6	3,613.8	4,182.1	4,738.0	5,305.3	6,043.9	6,733.7

^{*}Median

Real Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	2,409.2	3,514.9	4,740.4	6,132.6	7,706.1	9,574.5	11,628.4	14,096.6	16,744.4	19,722.8
75th perc.	2,221.1	3,128.3	4,153.0	5,232.5	6,546.3	7,932.3	9,499.9	11,215.6	13,071.3	15,113.9
50th perc.*	2,081.0	2,853.3	3,714.4	4,607.6	5,626.6	6,704.9	7,841.0	9,170.5	10,441.7	11,987.5
25th perc.	1,904.5	2,494.9	3,172.8	3,826.9	4,582.3	5,317.9	6,167.1	6,976.7	7,976.2	9,061.5
5th perc.	1,610.8	1,967.6	2,410.2	2,819.9	3,249.2	3,691.1	4,115.3	4,465.9	4,945.3	5,411.3

^{*}Median

Nominal Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	27.1%	20.4%	17.8%	15.6%	14.5%	13.7%	13.1%	12.6%	12.2%	11.9%
75th perc.	14.6%	12.5%	11.4%	10.8%	10.4%	10.1%	9.8%	9.6%	9.5%	9.4%
50th perc.*	7.7%	7.4%	7.8%	7.7%	7.8%	7.7%	7.6%	7.6%	7.6%	7.6%
25th perc.	1.2%	3.0%	4.2%	4.7%	5.2%	5.4%	5.6%	5.7%	5.9%	5.9%
5th perc.	-7.5%	-3.3%	-0.6%	0.7%	1.7%	2.5%	2.8%	3.2%	3.5%	3.8%

^{*}Median

Real Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	24.0%	17.7%	15.0%	13.0%	11.7%	11.0%	10.5%	10.0%	9.6%	9.4%
75th perc.	11.9%	9.8%	8.8%	8.2%	7.7%	7.5%	7.2%	7.1%	6.9%	6.7%
50th perc.*	5.2%	4.9%	5.2%	5.1%	5.1%	5.2%	5.1%	5.0%	5.1%	5.0%
25th perc.	-1.1%	0.3%	1.8%	2.2%	2.6%	2.9%	3.1%	3.1%	3.3%	3.4%
5th perc.	-9.9%	-5.4%	-3.0%	-1.8%	-0.9%	-0.1%	0.4%	0.7%	1.0%	1.3%

^{*}Median

Total Contributions in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	895.9	963.2	1,068.7	1,176.3	1,322.0	1,492.3	1,694.0	1,916.3	2,190.1	2,489.9
75th perc.	772.6	833.8	909.8	995.5	1,110.6	1,215.3	1,338.1	1,478.1	1,630.2	1,812.6
50th perc.*	699.6	747.7	806.9	878.0	952.8	1,011.6	1,081.5	1,187.7	1,265.7	1,386.3
25th perc.	577.0	416.2	410.0	404.2	441.5	462.8	501.5	542.2	571.3	656.5
5th perc.	276.8	280.9	295.3	306.7	317.3	328.9	342.7	347.2	364.3	370.6

^{*}Median

Portfolio E

Nominal Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	2,522.2	3,786.0	5,249.8	6,941.6	9,149.2	11,581.8	14,393.7	18,096.3	21,909.4	26,902.0
75th perc.	2,293.5	3,319.7	4,524.0	5,901.1	7,533.8	9,393.9	11,538.5	13,886.6	16,743.2	20,164.1
50th perc.*	2,138.9	2,998.9	4,012.1	5,134.5	6,452.7	7,843.7	9,358.5	11,246.1	13,203.4	15,567.4
25th perc.	1,944.2	2,599.2	3,387.1	4,190.0	5,102.9	6,141.7	7,269.1	8,478.4	9,790.1	11,411.2
5th perc.	1,623.4	2,024.4	2,511.4	3,016.4	3,555.8	4,130.2	4,691.8	5,214.6	5,938.3	6,652.8

^{*}Median

Real Value in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	2,454.6	3,601.7	4,864.5	6,346.5	7,971.3	9,933.7	12,081.9	14,602.8	17,515.6	20,588.4
75th perc.	2,237.3	3,158.2	4,199.6	5,312.2	6,649.2	8,086.9	9,706.4	11,473.3	13,393.4	15,501.1
50th perc.*	2,083.0	2,854.9	3,734.1	4,632.7	5,686.3	6,746.7	7,889.3	9,249.6	10,574.1	12,152.9
25th perc.	1,901.7	2,489.3	3,173.3	3,823.9	4,570.7	5,352.2	6,186.1	6,975.7	7,952.7	9,082.4
5th perc.	1,600.0	1,952.6	2,379.6	2,792.9	3,208.5	3,658.5	4,080.7	4,422.5	4,862.1	5,289.2

^{*}Median

Nominal Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	30.6%	22.7%	19.8%	17.2%	15.8%	14.9%	14.2%	13.7%	13.2%	12.8%
75th perc.	16.0%	13.5%	12.3%	11.6%	11.1%	10.8%	10.4%	10.2%	10.0%	9.9%
50th perc.*	8.0%	7.7%	8.1%	8.0%	8.1%	8.0%	7.9%	7.9%	7.9%	7.8%
25th perc.	0.6%	2.5%	4.0%	4.5%	5.1%	5.4%	5.5%	5.6%	5.8%	5.9%
5th perc.	-9.4%	-4.7%	-1.7%	-0.1%	1.0%	1.8%	2.3%	2.7%	3.1%	3.5%

^{*}Median

Real Returns in USD

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	27.4%	19.8%	16.8%	14.5%	13.0%	12.4%	11.6%	11.1%	10.5%	10.3%
75th perc.	13.2%	10.8%	9.6%	9.1%	8.5%	8.2%	7.9%	7.7%	7.4%	7.2%
50th perc.*	5.5%	5.2%	5.4%	5.4%	5.5%	5.5%	5.4%	5.3%	5.3%	5.3%
25th perc.	-1.7%	0.0%	1.5%	2.0%	2.5%	2.9%	3.1%	3.0%	3.2%	3.3%
5th perc.	-11.8%	-6.8%	-3.9%	-2.6%	-1.4%	-0.6%	0.0%	0.3%	0.8%	1.0%

^{*}Median

Total Contributions in USD (millions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	895.9	963.2	1,068.7	1,176.3	1,322.0	1,492.3	1,694.0	1,916.3	2,190.1	2,489.9
75th perc.	772.6	833.8	909.8	995.5	1,110.6	1,215.3	1,338.1	1,478.1	1,630.2	1,812.6
50th perc.*	699.6	747.7	806.9	878.0	952.8	1,011.6	1,081.5	1,187.7	1,265.7	1,386.3
25th perc.	577.0	416.2	410.0	404.2	441.5	462.8	501.5	542.2	571.3	656.5
5th perc.	276.8	280.9	295.3	306.7	317.3	328.9	342.7	347.2	364.3	370.6

^{*}Median

VIII. Monte-Carlo Simulation Results in Currency X Terms

FUND X

Current Portfolio

Nominal Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	5.5	6.3	7.6	9.9	12.3	15.0	18.6	22.8	27.3	31.6
75th perc.	4.8	5.1	5.6	6.7	8.0	9.4	11.0	12.6	14.8	16.9
50th perc.*	4.4	4.5	4.7	5.1	5.5	6.2	6.8	7.5	8.2	9.1
25th perc.	4.0	4.0	3.8	3.8	3.7	3.7	3.5	3.4	3.3	3.3
5th perc.	3.4	3.0	2.3	1.4	0.7	0.0	0.0	0.0	0.0	0.0

^{*}Median

Real Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	5.3	5.9	6.8	8.3	10.1	12.1	14.3	16.8	19.9	22.5
75th perc.	4.6	4.8	5.1	5.7	6.5	7.6	8.7	9.7	10.9	12.3
50th perc.*	4.2	4.2	4.2	4.4	4.6	5.0	5.3	5.6	6.0	6.7
25th perc.	3.9	3.8	3.5	3.3	3.2	3.1	2.8	2.6	2.5	2.3
5th perc.	3.3	2.9	2.2	1.3	0.7	0.0	0.0	0.0	0.0	0.0

^{*}Median

Nominal Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	27.1%	20.6%	18.2%	16.6%	15.4%	14.9%	14.2%	13.5%	13.1%	13.0%
75th perc.	14.5%	11.9%	10.9%	10.3%	9.8%	9.6%	9.2%	9.0%	8.9%	8.7%
50th perc.*	6.4%	6.1%	6.2%	6.1%	6.0%	5.9%	6.0%	6.0%	6.0%	6.0%
25th perc.	-1.7%	0.1%	1.2%	1.7%	2.0%	2.6%	2.9%	2.9%	3.0%	3.1%
5th perc.	-15.4%	-8.8%	-6.7%	-4.7%	-3.7%	-3.2%	-2.3%	-1.7%	-1.4%	-1.2%

^{*}Median

Real Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	23.6%	17.1%	14.7%	13.2%	12.3%	11.6%	10.9%	10.1%	9.8%	9.7%
75th perc.	11.2%	8.7%	7.8%	7.1%	6.7%	6.4%	6.1%	5.8%	5.7%	5.5%
50th perc.*	3.2%	3.0%	3.1%	3.0%	2.8%	2.8%	2.9%	2.9%	2.8%	2.7%
25th perc.	-4.8%	-3.0%	-2.0%	-1.3%	-1.1%	-0.7%	-0.4%	-0.3%	-0.1%	-0.1%
5th perc.	-18.0%	-12.1%	-9.6%	-7.5%	-6.6%	-6.1%	-5.2%	-4.7%	-4.3%	-4.0%

^{*}Median

Withdrawals from returns in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.3	0.4	0.4	0.5	0.6	0.8	1.0	1.1	1.3	1.5
75th perc.	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.5	0.6	0.6
50th perc.*	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
25th perc.	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
5th perc.	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Additional Withdrawals in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.4	0.8	1.0	1.2	1.3	1.4	1.5	1.6	1.9	2.1
75th perc.	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.2	0.2	0.2
50th perc.*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Total Withdrawals in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.6	1.0	1.2	1.4	1.5	1.5	1.7	1.9	2.2	2.4
75th perc.	0.3	0.4	0.4	0.5	0.6	0.6	0.8	0.9	1.0	1.1
50th perc.*	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.6
25th perc.	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3
5th perc.	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0

^{*}Median

Total Contributions in Currency X(trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.8	1.2	1.5	2.4	2.8	3.2	3.8	4.5	5.0	5.9
75th perc.	0.3	0.5	0.6	1.2	1.4	1.6	1.8	2.0	2.2	2.6
50th perc.*	0.0	0.0	0.0	0.4	0.5	0.5	0.5	0.6	0.7	0.9
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Efficient Mix Portfolio (Same Risk as Current Portfolio)

Nominal Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	5.5	6.3	7.6	9.8	12.3	15.0	18.6	22.8	27.3	31.6
75th perc.	4.8	5.1	5.6	6.7	8.0	9.4	11.0	12.6	14.8	16.9
50th perc.*	4.4	4.5	4.7	5.1	5.5	6.2	6.8	7.4	8.1	9.1
25th perc.	4.0	4.0	3.8	3.8	3.7	3.7	3.5	3.4	3.3	3.2
5th perc.	3.4	3.0	2.3	1.4	0.7	0.0	0.0	0.0	0.0	0.0

^{*}Median

Real Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	5.3	5.9	6.8	8.3	10.1	12.1	14.3	16.8	19.8	22.5
75th perc.	4.6	4.8	5.1	5.7	6.5	7.6	8.7	9.7	10.9	12.3
50th perc.*	4.2	4.2	4.2	4.4	4.6	5.0	5.3	5.6	6.0	6.7
25th perc.	3.9	3.8	3.5	3.3	3.2	3.1	2.8	2.6	2.5	2.3
5th perc.	3.3	2.9	2.2	1.3	0.7	0.0	0.0	0.0	0.0	0.0

^{*}Median

Nominal Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	27.8%	21.2%	18.8%	17.2%	16.0%	15.3%	14.6%	14.0%	13.5%	13.3%
75th perc.	15.1%	12.4%	11.4%	10.8%	10.3%	10.0%	9.7%	9.4%	9.4%	9.2%
50th perc.*	6.9%	6.7%	6.6%	6.6%	6.5%	6.4%	6.4%	6.5%	6.4%	6.5%
25th perc.	-1.4%	0.5%	1.6%	2.2%	2.4%	3.1%	3.3%	3.4%	3.5%	3.6%
5th perc.	-15.1%	-8.6%	-6.1%	-4.4%	-3.4%	-2.6%	-1.9%	-1.3%	-0.9%	-0.7%

^{*}Median

Real Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	24.2%	17.7%	15.2%	13.6%	12.7%	12.0%	11.2%	10.6%	10.1%	10.2%
75th perc.	11.7%	9.2%	8.2%	7.5%	7.2%	6.8%	6.5%	6.2%	6.2%	6.0%
50th perc.*	3.8%	3.6%	3.5%	3.4%	3.3%	3.2%	3.3%	3.3%	3.2%	3.2%
25th perc.	-4.3%	-2.6%	-1.6%	-0.9%	-0.7%	-0.2%	0.1%	0.2%	0.3%	0.3%
5th perc.	-17.8%	-11.5%	-9.1%	-7.2%	-6.3%	-5.7%	-4.8%	-4.2%	-3.9%	-3.7%

^{*}Median

Withdrawals from returns in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.4	0.4	0.5	0.5	0.7	0.8	1.0	1.1	1.5	1.6
75th perc.	0.3	0.3	0.3	0.3	0.4	0.4	0.5	0.6	0.6	0.7
50th perc.*	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3
25th perc.	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
5th perc.	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Additional Withdrawals in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.4	0.8	1.0	1.2	1.3	1.4	1.5	1.6	1.9	2.1
75th perc.	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.2	0.2	0.2
50th perc.*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Total Withdrawals in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.6	1.0	1.2	1.4	1.4	1.6	1.7	1.9	2.2	2.4
75th perc.	0.3	0.4	0.5	0.5	0.6	0.7	0.8	0.9	1.1	1.2
50th perc.*	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.5	0.6	0.6
25th perc.	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3
5th perc.	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0

^{*}Median

Total Contributions in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	8.0	1.2	1.5	2.4	2.8	3.2	3.8	4.5	5.0	5.9
75th perc.	0.3	0.5	0.6	1.2	1.4	1.6	1.8	2.0	2.2	2.6
50th perc.*	0.0	0.0	0.0	0.4	0.5	0.5	0.5	0.6	0.7	0.9
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Portfolio A

Nominal Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	5.5	6.3	7.6	9.8	12.2	15.0	18.5	22.7	27.1	31.3
75th perc.	4.8	5.1	5.6	6.7	8.0	9.4	11.0	12.6	14.7	16.7
50th perc.*	4.4	4.5	4.6	5.1	5.5	6.1	6.7	7.4	8.1	9.0
25th perc.	4.0	4.0	3.8	3.8	3.6	3.6	3.4	3.3	3.2	3.2
5th perc.	3.4	3.0	2.3	1.4	0.7	0.0	0.0	0.0	0.0	0.0

^{*}Median

Real Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	5.3	5.9	6.8	8.3	10.0	12.1	14.3	16.7	19.7	22.4
75th perc.	4.6	4.8	5.1	5.7	6.5	7.5	8.6	9.6	10.9	12.2
50th perc.*	4.2	4.2	4.2	4.4	4.6	5.0	5.3	5.5	6.0	6.6
25th perc.	3.9	3.7	3.5	3.3	3.1	3.0	2.8	2.6	2.4	2.3
5th perc.	3.3	2.9	2.2	1.3	0.6	0.0	0.0	0.0	0.0	0.0

^{*}Median

Nominal Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	30.4%	22.8%	20.2%	18.5%	17.5%	16.8%	15.8%	15.3%	14.6%	14.2%
75th perc.	16.7%	13.7%	12.6%	11.9%	11.4%	11.3%	10.9%	10.5%	10.5%	10.3%
50th perc.*	8.1%	7.7%	7.6%	7.6%	7.4%	7.4%	7.4%	7.4%	7.5%	7.4%
25th perc.	-0.6%	1.3%	2.3%	2.9%	3.3%	3.9%	4.2%	4.2%	4.4%	4.5%
5th perc.	-14.6%	-8.2%	-5.2%	-3.6%	-2.6%	-1.8%	-1.0%	-0.6%	-0.1%	0.2%

^{*}Median

Real Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	26.9%	19.3%	16.7%	15.2%	13.8%	13.3%	12.2%	11.7%	11.1%	11.0%
75th perc.	13.4%	10.4%	9.4%	8.7%	8.4%	7.9%	7.6%	7.3%	7.2%	7.0%
50th perc.*	4.8%	4.4%	4.5%	4.4%	4.1%	4.2%	4.4%	4.3%	4.2%	4.1%
25th perc.	-3.6%	-1.8%	-0.7%	-0.1%	0.3%	0.8%	1.0%	1.1%	1.2%	1.3%
5th perc.	-17.4%	-11.3%	-8.2%	-6.6%	-5.5%	-4.7%	-3.9%	-3.4%	-3.2%	-2.8%

^{*}Median

Withdrawals from returns in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.6	0.7	0.8	0.8	1.0	1.1	1.5	1.7	2.2	2.4
75th perc.	0.4	0.4	0.4	0.4	0.5	0.6	0.7	0.7	0.8	0.9
50th perc.*	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
25th perc.	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Additional Withdrawals in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.4	0.8	1.0	1.2	1.3	1.4	1.5	1.6	1.9	2.1
75th perc.	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.2	0.2	0.2
50th perc.*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Total Withdrawals in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	8.0	1.0	1.3	1.4	1.5	1.7	2.0	2.3	2.6	2.8
75th perc.	0.5	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.3	1.4
50th perc.*	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.6	0.6	0.7
25th perc.	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Total Contributions in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.8	1.2	1.5	2.4	2.8	3.2	3.8	4.5	5.0	5.9
75th perc.	0.3	0.5	0.6	1.2	1.4	1.6	1.8	2.0	2.2	2.6
50th perc.*	0.0	0.0	0.0	0.4	0.5	0.5	0.5	0.6	0.7	0.9
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Portfolio B

Nominal Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	5.5	6.3	7.6	9.8	12.2	15.0	18.5	22.7	27.1	31.3
75th perc.	4.8	5.1	5.6	6.7	7.9	9.3	10.9	12.5	14.6	16.7
50th perc.*	4.4	4.5	4.6	5.0	5.5	6.1	6.7	7.3	8.0	9.0
25th perc.	4.0	4.0	3.8	3.8	3.6	3.6	3.4	3.2	3.2	3.1
5th perc.	3.4	3.0	2.3	1.4	0.7	0.0	0.0	0.0	0.0	0.0

^{*}Median

Real Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	5.3	5.9	6.8	8.3	10.0	12.1	14.3	16.7	19.6	22.4
75th perc.	4.6	4.8	5.1	5.7	6.5	7.5	8.6	9.6	10.8	12.1
50th perc.*	4.2	4.2	4.2	4.3	4.6	5.0	5.2	5.5	6.0	6.5
25th perc.	3.9	3.7	3.5	3.3	3.1	3.0	2.7	2.6	2.4	2.2
5th perc.	3.3	2.9	2.1	1.3	0.6	0.0	0.0	0.0	0.0	0.0

^{*}Median

Nominal Returns in Churrency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	31.0%	23.2%	20.8%	18.9%	18.0%	17.0%	16.0%	15.6%	14.9%	14.5%
75th perc.	16.8%	14.0%	12.9%	12.2%	11.7%	11.4%	11.3%	10.7%	10.7%	10.5%
50th perc.*	8.3%	7.8%	7.8%	7.7%	7.7%	7.5%	7.6%	7.6%	7.7%	7.7%
25th perc.	-0.6%	1.3%	2.4%	3.0%	3.5%	4.1%	4.3%	4.4%	4.5%	4.8%
5th perc.	-15.1%	-8.3%	-5.3%	-3.6%	-2.5%	-1.8%	-0.8%	-0.3%	0.0%	0.4%

^{*}Median

Real Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	27.3%	19.7%	17.1%	15.6%	14.2%	13.5%	12.6%	12.0%	11.3%	11.2%
75th perc.	13.6%	10.7%	9.6%	8.9%	8.6%	8.1%	7.9%	7.6%	7.5%	7.2%
50th perc.*	5.0%	4.5%	4.6%	4.6%	4.3%	4.4%	4.5%	4.4%	4.4%	4.4%
25th perc.	-3.7%	-1.8%	-0.6%	0.0%	0.5%	0.9%	1.1%	1.3%	1.4%	1.5%
5th perc.	-17.6%	-11.5%	-8.2%	-6.4%	-5.6%	-4.6%	-3.8%	-3.3%	-2.9%	-2.8%

^{*}Median

Withdrawals from returns in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.7	0.7	0.8	0.9	1.1	1.3	1.7	1.9	2.4	2.6
75th perc.	0.4	0.4	0.5	0.5	0.5	0.6	0.7	0.8	0.8	1.0
50th perc.*	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
25th perc.	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Additional Withdrawals in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.4	0.8	1.0	1.2	1.3	1.4	1.5	1.6	1.9	2.1
75th perc.	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.2	0.2	0.2
50th perc.*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Total Withdrawals in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.8	1.1	1.3	1.5	1.6	1.8	2.1	2.4	2.7	2.9
75th perc.	0.5	0.6	0.7	0.7	0.8	0.9	1.1	1.2	1.4	1.5
50th perc.*	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.7
25th perc.	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Total Contributions in Currency X(trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.8	1.2	1.5	2.4	2.8	3.2	3.8	4.5	5.0	5.9
75th perc.	0.3	0.5	0.6	1.2	1.4	1.6	1.8	2.0	2.2	2.6
50th perc.*	0.0	0.0	0.0	0.4	0.5	0.5	0.5	0.6	0.7	0.9
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Portfolio C

Nominal Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	5.5	6.3	7.6	9.8	12.2	14.9	18.4	22.7	27.1	31.2
75th perc.	4.8	5.1	5.6	6.7	7.9	9.3	10.9	12.4	14.5	16.6
50th perc.*	4.3	4.5	4.6	5.0	5.4	6.1	6.6	7.3	8.0	8.9
25th perc.	4.0	3.9	3.8	3.7	3.6	3.6	3.4	3.2	3.1	3.1
5th perc.	3.4	3.0	2.3	1.4	0.6	0.0	0.0	0.0	0.0	0.0

^{*}Median

Real Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	5.3	5.9	6.8	8.3	10.0	12.1	14.2	16.6	19.6	22.3
75th perc.	4.6	4.8	5.1	5.7	6.5	7.5	8.5	9.6	10.7	12.0
50th perc.*	4.2	4.2	4.2	4.3	4.6	5.0	5.2	5.5	5.9	6.4
25th perc.	3.9	3.7	3.5	3.3	3.1	3.0	2.7	2.5	2.3	2.2
5th perc.	3.3	2.8	2.1	1.3	0.6	0.0	0.0	0.0	0.0	0.0

^{*}Median

Nominal Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	31.9%	23.9%	21.5%	19.6%	18.3%	17.3%	16.3%	15.8%	15.3%	14.8%
75th perc.	17.2%	14.3%	13.3%	12.5%	12.0%	11.8%	11.5%	11.0%	10.9%	10.8%
50th perc.*	8.4%	7.9%	7.9%	7.9%	7.8%	7.7%	7.8%	7.8%	7.9%	7.9%
25th perc.	-0.7%	1.3%	2.5%	3.2%	3.6%	4.2%	4.5%	4.7%	4.7%	4.9%
5th perc.	-15.3%	-8.6%	-5.4%	-3.5%	-2.5%	-1.8%	-0.8%	-0.2%	0.2%	0.5%

^{*}Median

Real Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	28.4%	20.4%	17.5%	16.1%	14.6%	13.8%	12.9%	12.3%	11.6%	11.4%
75th perc.	13.8%	11.0%	9.8%	9.2%	8.9%	8.3%	8.1%	7.9%	7.7%	7.5%
50th perc.*	5.1%	4.6%	4.8%	4.7%	4.5%	4.6%	4.7%	4.6%	4.7%	4.6%
25th perc.	-3.7%	-1.8%	-0.6%	0.1%	0.6%	1.1%	1.3%	1.4%	1.7%	1.7%
5th perc.	-17.8%	-11.5%	-8.2%	-6.3%	-5.5%	-4.6%	-3.8%	-3.2%	-2.9%	-2.6%

^{*}Median

Withdrawals from returns in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.7	0.8	0.9	1.0	1.2	1.4	1.8	2.0	2.6	2.8
75th perc.	0.5	0.5	0.5	0.5	0.6	0.7	0.7	0.8	0.9	1.0
50th perc.*	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
25th perc.	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Additional Withdrawals in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.4	0.8	1.0	1.2	1.3	1.4	1.5	1.6	1.9	2.1
75th perc.	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.2	0.2	0.2
50th perc.*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Total Withdrawals in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.9	1.1	1.4	1.5	1.7	1.9	2.2	2.5	2.9	3.1
75th perc.	0.5	0.6	0.7	0.8	0.8	1.0	1.1	1.2	1.4	1.5
50th perc.*	0.3	0.4	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.8
25th perc.	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Total Contributions in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.8	1.2	1.5	2.4	2.8	3.2	3.8	4.5	5.0	5.9
75th perc.	0.3	0.5	0.6	1.2	1.4	1.6	1.8	2.0	2.2	2.6
50th perc.*	0.0	0.0	0.0	0.4	0.5	0.5	0.5	0.6	0.7	0.9
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Portfolio D (Recommendation)

Nominal Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	5.4	6.3	7.6	9.8	12.2	14.9	18.2	22.6	27.0	31.0
75th perc.	4.8	5.1	5.6	6.6	7.9	9.3	10.8	12.4	14.4	16.4
50th perc.*	4.3	4.5	4.6	5.0	5.4	6.0	6.6	7.3	7.9	8.8
25th perc.	4.0	3.9	3.8	3.7	3.6	3.6	3.3	3.2	3.0	3.0
5th perc.	3.4	3.0	2.3	1.4	0.6	0.0	0.0	0.0	0.0	0.0

^{*}Median

Real Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	5.3	5.9	6.8	8.3	10.0	12.0	14.2	16.5	19.5	22.1
75th perc.	4.6	4.8	5.1	5.6	6.5	7.4	8.5	9.5	10.6	11.9
50th perc.*	4.2	4.2	4.2	4.3	4.5	4.9	5.2	5.4	5.9	6.4
25th perc.	3.9	3.7	3.5	3.2	3.0	3.0	2.7	2.5	2.3	2.2
5th perc.	3.3	2.8	2.1	1.2	0.6	0.0	0.0	0.0	0.0	0.0

^{*}Median

Nominal Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	32.5%	24.5%	22.1%	20.1%	18.6%	17.8%	16.7%	16.2%	15.6%	15.1%
75th perc.	17.6%	14.7%	13.6%	12.9%	12.4%	12.0%	11.7%	11.3%	11.2%	11.1%
50th perc.*	8.5%	7.9%	8.2%	8.2%	8.0%	8.0%	8.0%	8.0%	8.1%	8.1%
25th perc.	-1.0%	1.2%	2.6%	3.2%	3.8%	4.4%	4.7%	4.8%	4.9%	5.1%
5th perc.	-15.4%	-8.8%	-5.4%	-3.5%	-2.5%	-1.7%	-0.7%	0.0%	0.3%	0.6%

^{*}Median

Real Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	29.2%	20.8%	18.3%	16.4%	15.0%	14.1%	13.3%	12.6%	12.0%	11.7%
75th perc.	14.4%	11.4%	10.1%	9.5%	9.1%	8.6%	8.4%	8.1%	7.9%	7.8%
50th perc.*	5.1%	4.7%	4.9%	5.0%	4.7%	4.8%	4.9%	4.8%	4.9%	4.8%
25th perc.	-3.9%	-2.0%	-0.6%	0.1%	0.7%	1.2%	1.4%	1.6%	1.8%	1.9%
5th perc.	-17.9%	-11.3%	-8.4%	-6.3%	-5.4%	-4.6%	-3.7%	-3.1%	-2.8%	-2.4%

^{*}Median

Withdrawals from returns in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.8	0.9	1.0	1.1	1.3	1.5	2.0	2.2	2.9	3.0
75th perc.	0.5	0.5	0.5	0.5	0.6	0.7	0.8	0.9	0.9	1.1
50th perc.*	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
25th perc.	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Additional Withdrawals in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.4	0.8	1.0	1.2	1.3	1.4	1.5	1.6	1.9	2.1
75th perc.	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.2	0.2	0.2
50th perc.*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Total Withdrawals in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1.0	1.1	1.4	1.6	1.7	2.0	2.4	2.6	3.1	3.3
75th perc.	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.3	1.5	1.6
50th perc.*	0.3	0.4	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.8
25th perc.	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Total Contributions in Currency X(trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	8.0	1.2	1.5	2.4	2.8	3.2	3.8	4.5	5.0	5.9
75th perc.	0.3	0.5	0.6	1.2	1.4	1.6	1.8	2.0	2.2	2.6
50th perc.*	0.0	0.0	0.0	0.4	0.5	0.5	0.5	0.6	0.7	0.9
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Portfolio E

Nominal Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	5.4	6.3	7.6	9.8	12.1	14.8	18.1	22.6	27.0	30.8
75th perc.	4.8	5.1	5.6	6.6	7.8	9.2	10.7	12.3	14.3	16.3
50th perc.*	4.3	4.4	4.5	4.9	5.3	6.0	6.6	7.2	7.8	8.8
25th perc.	4.0	3.9	3.8	3.7	3.5	3.5	3.3	3.1	2.9	2.9
5th perc.	3.4	3.0	2.3	1.3	0.6	0.0	0.0	0.0	0.0	0.0

^{*}Median

Real Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	5.3	5.9	6.8	8.3	9.9	11.9	14.1	16.4	19.5	22.1
75th perc.	4.6	4.8	5.1	5.6	6.4	7.4	8.5	9.5	10.6	11.8
50th perc.*	4.2	4.2	4.2	4.3	4.5	4.9	5.1	5.4	5.8	6.3
25th perc.	3.9	3.7	3.4	3.2	3.0	2.9	2.6	2.4	2.2	2.1
5th perc.	3.3	2.8	2.1	1.2	0.5	0.0	0.0	0.0	0.0	0.0

^{*}Median

Nominal Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	33.7%	25.4%	22.4%	20.6%	19.1%	18.3%	17.1%	16.6%	15.9%	15.4%
75th perc.	18.3%	15.1%	13.7%	13.1%	12.6%	12.3%	12.0%	11.6%	11.5%	11.4%
50th perc.*	8.5%	8.0%	8.4%	8.3%	8.2%	8.1%	8.2%	8.2%	8.4%	8.3%
25th perc.	-1.0%	1.1%	2.6%	3.3%	4.0%	4.5%	4.8%	4.9%	5.0%	5.3%
5th perc.	-15.8%	-9.0%	-5.5%	-3.5%	-2.5%	-1.6%	-0.6%	0.1%	0.3%	0.7%

^{*}Median

Real Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	29.8%	21.6%	18.8%	17.1%	15.6%	14.5%	13.5%	13.1%	12.3%	12.1%
75th perc.	15.0%	11.8%	10.3%	9.8%	9.3%	9.0%	8.6%	8.4%	8.2%	8.0%
50th perc.*	5.2%	4.8%	5.1%	5.0%	4.9%	5.0%	5.1%	4.9%	5.2%	5.0%
25th perc.	-3.8%	-1.9%	-0.6%	0.2%	0.7%	1.4%	1.5%	1.7%	1.9%	2.0%
5th perc.	-18.3%	-11.7%	-8.6%	-6.4%	-5.3%	-4.6%	-3.6%	-3.1%	-2.7%	-2.3%

^{*}Median

Withdrawals from returns in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.9	0.9	1.1	1.2	1.5	1.7	2.1	2.4	3.1	3.3
75th perc.	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.9	1.0	1.1
50th perc.*	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
25th perc.	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Additional Withdrawals in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.4	0.8	1.0	1.2	1.3	1.4	1.5	1.6	1.9	2.1
75th perc.	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.2	0.2	0.2
50th perc.*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Total Withdrawals in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1.0	1.2	1.5	1.6	1.8	2.1	2.5	2.7	3.3	3.5
75th perc.	0.6	0.7	0.8	0.9	0.9	1.1	1.2	1.3	1.5	1.7
50th perc.*	0.3	0.4	0.4	0.5	0.5	0.5	0.6	0.7	0.7	0.8
25th perc.	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

Total Contributions in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.8	1.2	1.5	2.4	2.8	3.2	3.8	4.5	5.0	5.9
75th perc.	0.3	0.5	0.6	1.2	1.4	1.6	1.8	2.0	2.2	2.6
50th perc.*	0.0	0.0	0.0	0.4	0.5	0.5	0.5	0.6	0.7	0.9
25th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5th perc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^{*}Median

FUND Y

Current Portfolio

Nominal Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1.3	1.8	2.5	3.2	4.1	5.0	6.1	7.3	9.0	10.5
75th perc.	1.2	1.6	2.2	2.8	3.5	4.3	5.2	6.1	7.3	8.5
50th perc.*	1.1	1.5	2.0	2.5	3.1	3.7	4.4	5.2	6.0	7.0
25th perc.	1.0	1.3	1.7	2.1	2.5	3.0	3.5	4.1	4.7	5.3
5th perc.	0.8	1.1	1.3	1.6	1.9	2.1	2.4	2.7	3.0	3.5

^{*}Median

Real Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1.2	1.7	2.3	2.8	3.4	4.2	4.9	5.7	6.8	7.6
75th perc.	1.1	1.5	2.0	2.5	3.0	3.6	4.2	4.8	5.5	6.2
50th perc.*	1.1	1.4	1.8	2.2	2.6	3.1	3.6	4.0	4.6	5.1
25th perc.	1.0	1.3	1.6	1.9	2.2	2.5	2.8	3.2	3.6	3.9
5th perc.	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.7

^{*}Median

Nominal Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	27.1%	20.5%	18.2%	16.6%	15.4%	14.9%	14.1%	13.5%	13.1%	13.0%
75th perc.	14.5%	11.9%	10.9%	10.3%	9.8%	9.6%	9.2%	9.0%	8.9%	8.7%
50th perc.*	6.4%	6.1%	6.2%	6.1%	6.0%	5.9%	6.0%	6.0%	5.9%	6.0%
25th perc.	-1.7%	0.1%	1.2%	1.7%	2.0%	2.6%	2.9%	2.9%	3.0%	3.1%
5th perc.	-15.4%	-8.9%	-6.7%	-4.7%	-3.7%	-3.2%	-2.3%	-1.7%	-1.4%	-1.2%

^{*}Median

Real Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	23.6%	17.1%	14.7%	13.2%	12.3%	11.6%	10.9%	10.1%	9.7%	9.6%
75th perc.	11.2%	8.7%	7.7%	7.1%	6.7%	6.4%	6.1%	5.8%	5.6%	5.5%
50th perc.*	3.2%	3.0%	3.1%	3.0%	2.8%	2.8%	2.9%	2.9%	2.8%	2.7%
25th perc.	-4.8%	-3.0%	-2.0%	-1.4%	-1.1%	-0.7%	-0.4%	-0.3%	-0.1%	-0.1%
5th perc.	-18.0%	-12.2%	-9.6%	-7.5%	-6.6%	-6.1%	-5.3%	-4.7%	-4.3%	-4.1%

^{*}Median

Total Contributions in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.4	0.4	0.5	0.6	0.6	0.7	0.8	1.0	1.1	1.3
75th perc.	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.8	0.8	0.9
50th perc.*	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.7	0.7
25th perc.	0.3	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
5th perc.	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

^{*}Median

Portfolio A [Recommendation 1 (Maintains Policy)]

Nominal Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1.3	1.9	2.7	3.5	4.5	5.7	7.0	8.6	10.5	12.5
75th perc.	1.2	1.7	2.3	3.0	3.8	4.7	5.7	6.8	8.2	9.7
50th perc.*	1.1	1.6	2.1	2.6	3.2	4.0	4.8	5.7	6.7	7.8
25th perc.	1.0	1.4	1.7	2.2	2.6	3.2	3.7	4.3	5.0	5.7
5th perc.	0.8	1.1	1.3	1.6	1.9	2.2	2.5	2.8	3.1	3.6

^{*}Median

Real Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1.3	1.8	2.4	3.1	3.8	4.7	5.6	6.6	7.8	9.0
75th perc.	1.2	1.6	2.1	2.6	3.2	3.9	4.6	5.3	6.2	7.0
50th perc.*	1.1	1.5	1.9	2.3	2.8	3.3	3.8	4.4	5.0	5.7
25th perc.	1.0	1.3	1.6	1.9	2.3	2.7	3.0	3.4	3.8	4.3
5th perc.	0.8	1.0	1.2	1.4	1.6	1.8	2.1	2.2	2.5	2.8

^{*}Median

Nominal Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	33.6%	25.2%	22.5%	20.4%	18.9%	18.0%	17.0%	16.3%	15.7%	15.2%
75th perc.	17.9%	15.0%	13.8%	12.9%	12.5%	12.1%	11.9%	11.5%	11.3%	11.2%
50th perc.*	8.6%	8.1%	8.2%	8.2%	8.1%	8.0%	8.1%	8.0%	8.2%	8.2%
25th perc.	-0.8%	1.2%	2.6%	3.3%	3.9%	4.4%	4.6%	4.8%	4.8%	5.1%
5th perc.	-15.8%	-9.0%	-5.6%	-3.6%	-2.6%	-1.7%	-0.6%	-0.1%	0.3%	0.6%

^{*}Median

Real Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	29.6%	21.1%	18.7%	16.7%	15.3%	14.2%	13.5%	12.7%	12.0%	11.8%
75th perc.	14.7%	11.6%	10.2%	9.6%	9.2%	8.8%	8.5%	8.2%	7.9%	7.8%
50th perc.*	5.3%	4.9%	5.0%	5.0%	4.8%	4.8%	5.0%	4.8%	4.9%	4.8%
25th perc.	-3.8%	-1.8%	-0.6%	0.2%	0.7%	1.3%	1.4%	1.5%	1.7%	1.9%
5th perc.	-18.2%	-11.6%	-8.5%	-6.4%	-5.5%	-4.6%	-3.6%	-3.0%	-2.9%	-2.4%

^{*}Median

Total Contributions in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.4	0.4	0.5	0.6	0.6	0.7	0.8	1.0	1.1	1.3
75th perc.	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.8	0.8	0.9
50th perc.*	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.7	0.7
25th perc.	0.3	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
5th perc.	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

^{*}Median

Portfolio B

Nominal Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1.3	1.9	2.7	3.5	4.5	5.6	6.9	8.4	10.4	12.3
75th perc.	1.2	1.7	2.3	3.0	3.8	4.7	5.7	6.8	8.2	9.6
50th perc.*	1.1	1.6	2.1	2.6	3.2	4.0	4.8	5.6	6.6	7.8
25th perc.	1.0	1.4	1.7	2.2	2.6	3.2	3.7	4.3	5.0	5.8
5th perc.	0.9	1.1	1.3	1.6	1.9	2.2	2.5	2.8	3.2	3.7

^{*}Median

Real Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1.3	1.8	2.4	3.1	3.8	4.6	5.6	6.6	7.8	9.0
75th perc.	1.2	1.6	2.1	2.6	3.2	3.9	4.6	5.3	6.2	7.0
50th perc.*	1.1	1.5	1.9	2.3	2.8	3.3	3.8	4.4	5.0	5.7
25th perc.	1.0	1.3	1.6	1.9	2.3	2.6	3.0	3.4	3.8	4.2
5th perc.	0.8	1.0	1.2	1.4	1.6	1.9	2.1	2.2	2.5	2.8

^{*}Median

Nominal Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	32.7%	24.4%	21.8%	19.9%	18.5%	17.7%	16.6%	16.1%	15.4%	15.0%
75th perc.	17.7%	14.6%	13.5%	12.8%	12.3%	12.0%	11.7%	11.3%	11.2%	11.1%
50th perc.*	8.4%	7.8%	8.1%	8.1%	8.0%	7.9%	8.0%	8.0%	8.2%	8.1%
25th perc.	-0.8%	1.3%	2.7%	3.2%	3.8%	4.4%	4.7%	4.7%	4.9%	5.1%
5th perc.	-15.2%	-8.7%	-5.3%	-3.4%	-2.5%	-1.8%	-0.8%	0.0%	0.4%	0.7%

^{*}Median

Real Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	28.8%	20.9%	18.1%	16.5%	15.0%	14.1%	13.2%	12.6%	12.0%	11.8%
75th perc.	14.3%	11.3%	10.1%	9.6%	9.1%	8.6%	8.3%	8.1%	7.9%	7.8%
50th perc.*	4.9%	4.7%	4.9%	4.9%	4.7%	4.8%	4.9%	4.8%	4.9%	4.8%
25th perc.	-4.0%	-1.9%	-0.6%	0.1%	0.7%	1.2%	1.4%	1.5%	1.7%	1.9%
5th perc.	-17.7%	-11.5%	-8.2%	-6.4%	-5.4%	-4.5%	-3.7%	-3.2%	-2.8%	-2.4%

^{*}Median

Total Contributions in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.4	0.4	0.5	0.6	0.6	0.7	0.8	1.0	1.1	1.3
75th perc.	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.8	0.8	0.9
50th perc.*	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.7	0.7
25th perc.	0.3	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
5th perc.	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

^{*}Median

Portfolio C

Nominal Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1.3	2.0	2.8	3.7	4.7	6.0	7.4	9.2	11.3	13.5
75th perc.	1.2	1.7	2.4	3.1	3.9	4.9	5.9	7.1	8.6	10.1
50th perc.*	1.1	1.6	2.1	2.7	3.3	4.1	4.9	5.7	6.8	8.0
25th perc.	1.0	1.4	1.7	2.2	2.7	3.2	3.8	4.4	5.1	5.9
5th perc.	0.8	1.1	1.3	1.6	1.9	2.2	2.4	2.7	3.1	3.6

^{*}Median

Real Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1.3	1.9	2.5	3.2	4.0	5.0	6.0	7.0	8.3	9.8
75th perc.	1.2	1.6	2.1	2.7	3.3	4.0	4.8	5.5	6.5	7.4
50th perc.*	1.1	1.5	1.9	2.4	2.8	3.4	3.9	4.5	5.2	5.9
25th perc.	1.0	1.3	1.6	1.9	2.3	2.7	3.1	3.5	3.9	4.3
5th perc.	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.7

^{*}Median

Nominal Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	37.1%	27.7%	24.5%	22.0%	20.2%	19.5%	18.3%	17.5%	16.7%	16.2%
75th perc.	19.5%	16.1%	14.5%	14.0%	13.4%	13.0%	12.7%	12.4%	12.1%	12.0%
50th perc.*	8.9%	8.6%	8.8%	8.7%	8.7%	8.6%	8.7%	8.7%	8.8%	8.8%
25th perc.	-1.2%	1.1%	2.7%	3.6%	4.1%	4.8%	5.0%	5.0%	5.2%	5.6%
5th perc.	-16.4%	-9.6%	-5.9%	-3.6%	-2.7%	-1.6%	-0.5%	0.1%	0.5%	1.0%

^{*}Median

Real Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	33.1%	23.9%	20.6%	18.5%	16.9%	15.7%	14.5%	14.0%	13.2%	12.8%
75th perc.	16.0%	12.6%	11.3%	10.7%	10.1%	9.8%	9.4%	9.1%	8.8%	8.8%
50th perc.*	5.4%	5.1%	5.4%	5.4%	5.3%	5.4%	5.5%	5.5%	5.6%	5.5%
25th perc.	-4.1%	-2.0%	-0.6%	0.4%	1.0%	1.6%	1.7%	1.8%	2.0%	2.3%
5th perc.	-18.9%	-12.3%	-8.7%	-6.7%	-5.5%	-4.5%	-3.5%	-3.1%	-2.7%	-2.2%

^{*}Median

Total Contributions in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.4	0.4	0.5	0.6	0.6	0.7	0.8	1.0	1.1	1.3
75th perc.	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.8	0.8	0.9
50th perc.*	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.7	0.7
25th perc.	0.3	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
5th perc.	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

^{*}Median

Portfolio D [Recommendation 2 (Relaxes Policy)]

Nominal Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1.3	2.0	2.8	3.7	4.8	6.1	7.6	9.4	11.6	13.8
75th perc.	1.2	1.7	2.4	3.1	3.9	4.9	6.0	7.2	8.7	10.2
50th perc.*	1.1	1.6	2.1	2.7	3.3	4.1	4.9	5.8	6.9	8.1
25th perc.	1.0	1.4	1.8	2.2	2.7	3.2	3.8	4.4	5.1	5.9
5th perc.	0.8	1.1	1.3	1.5	1.9	2.1	2.4	2.7	3.1	3.6

^{*}Median

Real Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1.3	1.9	2.6	3.3	4.1	5.1	6.1	7.2	8.6	10.0
75th perc.	1.2	1.6	2.2	2.7	3.4	4.1	4.8	5.6	6.6	7.5
50th perc.*	1.1	1.5	1.9	2.4	2.8	3.4	3.9	4.5	5.2	5.9
25th perc.	1.0	1.3	1.6	1.9	2.3	2.7	3.1	3.5	3.9	4.3
5th perc.	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.7

^{*}Median

Nominal Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	38.2%	28.6%	25.3%	22.5%	20.7%	20.0%	18.6%	17.9%	17.1%	16.5%
75th perc.	19.9%	16.6%	14.8%	14.4%	13.7%	13.2%	12.9%	12.7%	12.3%	12.2%
50th perc.*	9.0%	8.7%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.9%	8.9%
25th perc.	-1.4%	0.9%	2.7%	3.6%	4.2%	4.9%	5.0%	5.1%	5.3%	5.7%
5th perc.	-16.9%	-9.9%	-6.0%	-3.8%	-2.8%	-1.6%	-0.5%	0.0%	0.5%	0.9%

^{*}Median

Real Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	29.6%	21.1%	18.7%	16.7%	15.3%	14.2%	13.5%	12.7%	12.0%	11.8%
75th perc.	14.7%	11.6%	10.2%	9.6%	9.2%	8.8%	8.5%	8.2%	7.9%	7.8%
50th perc.*	5.3%	4.9%	5.0%	5.0%	4.8%	4.8%	5.0%	4.8%	4.9%	4.8%
25th perc.	-3.8%	-1.8%	-0.6%	0.2%	0.7%	1.3%	1.4%	1.5%	1.7%	1.9%
5th perc.	-18.2%	-11.6%	-8.5%	-6.4%	-5.5%	-4.6%	-3.6%	-3.0%	-2.9%	-2.4%

^{*}Median

Total Contributions in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.4	0.4	0.5	0.6	0.6	0.7	0.8	1.0	1.1	1.3
75th perc.	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.8	0.8	0.9
50th perc.*	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.7	0.7
25th perc.	0.3	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
5th perc.	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

^{*}Median

Portfolio B

Nominal Value in Currency (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1.3	1.9	2.7	3.5	4.5	5.6	6.9	8.4	10.4	12.3
75th perc.	1.2	1.7	2.3	3.0	3.8	4.7	5.7	6.8	8.2	9.6
50th perc.*	1.1	1.6	2.1	2.6	3.2	4.0	4.8	5.6	6.6	7.8
25th perc.	1.0	1.4	1.7	2.2	2.6	3.2	3.7	4.3	5.0	5.8
5th perc.	0.9	1.1	1.3	1.6	1.9	2.2	2.5	2.8	3.2	3.7

^{*}Median

Real Value in Currency X (trillions)

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1.3	1.9	2.6	3.4	4.2	5.3	6.3	7.5	8.9	10.6
75th perc.	1.2	1.6	2.2	2.8	3.4	4.1	4.9	5.7	6.7	7.7
50th perc.*	1.1	1.5	1.9	2.4	2.8	3.4	4.0	4.6	5.3	6.0
25th perc.	1.0	1.3	1.6	2.0	2.3	2.7	3.1	3.5	3.9	4.4
5th perc.	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.1	2.4	2.7

^{*}Median

Nominal Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	40.4%	30.4%	26.9%	23.9%	22.0%	20.8%	19.5%	18.9%	17.9%	17.3%
75th perc.	21.0%	17.2%	15.7%	14.8%	14.2%	13.8%	13.3%	13.1%	12.9%	12.6%
50th perc.*	9.2%	8.9%	9.1%	9.1%	9.1%	9.1%	9.1%	9.0%	9.1%	9.1%
25th perc.	-1.6%	0.8%	2.6%	3.6%	4.3%	5.0%	5.1%	5.1%	5.4%	5.8%
5th perc.	-17.5%	-10.3%	-6.5%	-3.9%	-3.1%	-1.4%	-0.7%	-0.1%	0.4%	1.0%

^{*}Median

Real Returns in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	36.4%	26.5%	23.2%	20.2%	18.3%	17.0%	15.9%	15.2%	14.4%	14.0%
75th perc.	17.4%	13.8%	12.4%	11.6%	10.8%	10.5%	10.1%	9.7%	9.5%	9.3%
50th perc.*	5.7%	5.7%	5.9%	5.8%	5.8%	5.8%	5.8%	5.8%	6.0%	5.9%
25th perc.	-4.6%	-2.1%	-0.6%	0.4%	1.1%	1.7%	1.8%	2.0%	2.2%	2.5%
5th perc.	-19.8%	-12.9%	-9.3%	-6.9%	-5.9%	-4.4%	-3.7%	-3.2%	-2.7%	-2.3%

^{*}Median

Total Contributions in Currency X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.4	0.4	0.5	0.6	0.6	0.7	0.8	1.0	1.1	1.3
75th perc.	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.8	0.8	0.9
50th perc.*	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.7	0.7
25th perc.	0.3	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
5th perc.	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

^{*}Median

Contributions as a Percentage of Country X GDP

FUND X

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	1.0%	1.4%	1.5%	2.2%	2.3%	2.4%	2.4%	2.5%	2.5%	2.6%
75th perc.	0.4%	0.5%	0.6%	1.2%	1.2%	1.3%	1.3%	1.3%	1.4%	1.4%
50th perc.*	0.0%	0.0%	0.0%	0.4%	0.5%	0.5%	0.4%	0.4%	0.5%	0.5%
25th perc.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
5th perc.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

^{*}Median

FUND Y

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
75th perc.	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
50th perc.*	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
25th perc.	0.4%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
5th perc.	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%

^{*}Median

Withdrawals as a Percentage of Country X GDP

FUND x

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	0.5%	1.0%	1.2%	1.4%	1.4%	1.4%	1.4%	1.5%	1.6%	1.7%
75th perc.	0.0%	0.0%	0.0%	0.1%	0.0%	0.1%	0.1%	0.1%	0.2%	0.1%
50th perc.*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
25th perc.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
5th perc.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

^{*}Median

Economic Variables

Expected Country X Real GDP Variations

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	9.4%	11.1%	11.7%	12.3%	12.6%	12.8%	12.8%	13.1%	13.4%	13.7%
75th perc.	6.6%	7.3%	7.6%	7.8%	8.1%	8.2%	8.3%	8.1%	8.2%	8.5%
50th perc.*	4.9%	5.0%	5.0%	5.0%	5.0%	5.0%	4.9%	5.0%	4.9%	5.1%
25th perc.	3.2%	2.8%	2.2%	2.0%	2.1%	1.9%	1.8%	1.8%	1.6%	1.7%
5th perc.	0.7%	-0.7%	-1.5%	-1.9%	-2.0%	-2.7%	-2.9%	-2.6%	-2.9%	-3.1%

^{*}Median

Expected the Commodity Price Returns

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	54.8%	58.0%	53.7%	56.0%	59.2%	58.0%	55.7%	57.5%	57.0%	61.7%
75th perc.	23.6%	24.0%	22.3%	23.8%	24.9%	23.8%	22.2%	21.7%	23.0%	25.0%
50th perc.*	5.9%	5.1%	5.0%	4.6%	4.9%	4.5%	4.7%	3.8%	4.7%	5.3%
25th perc.	-11.5%	-11.1%	-11.8%	-12.8%	-11.3%	-12.4%	-11.3%	-12.1%	-12.8%	-11.8%
5th perc.	-31.7%	-31.3%	-31.6%	-33.1%	-32.1%	-32.0%	-32.7%	-33.4%	-34.0%	-33.0%

^{*}Median

Country X Inflation

Iteration #	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
95th perc.	5.3%	5.5%	5.8%	5.9%	5.8%	5.8%	5.9%	6.0%	6.0%	6.0%
75th perc.	3.9%	4.1%	4.2%	4.1%	4.2%	4.2%	4.3%	4.2%	4.3%	4.3%
50th perc.*	3.1%	3.1%	3.0%	3.0%	3.0%	3.0%	3.1%	3.1%	3.1%	3.1%
25th perc.	2.3%	2.1%	2.0%	2.0%	2.0%	1.9%	1.9%	2.0%	2.0%	1.9%
5th perc.	1.0%	0.6%	0.4%	0.4%	0.4%	0.2%	0.4%	0.4%	0.4%	0.3%

^{*}Median

IX. Index Descriptions

MSCI All Country World Index (ACWI) - Global Equity Index

The MSCI All Country World Index is a global index, which measures the performance of stock markets in the United States, Europe, Canada, Australia, New Zealand, the Far East and the Emerging Markets. In effect, this index combines the EAFE Index and the Emerging Markets Free Index in addition to Canada and the United States. As of 30 June, 2007, the index was comprised of the following 49 countries:

Developed Markets (89% of the MSCI ACWI Index as of June 30, 2007)

Australia	Denmark	Greece	Japan	Portugal	Switzerland
Austria	Finland	Hong Kong	Netherlands	Singapore	United Kingdom
Belgium	France	Ireland	New Zealand	Spain	United States
Canada	Germany	Italy	Norway	Sweden	

Emerging Markets (11% of the MSCI ACWI Index as of June 30, 2007)

Argentina	Colombia	India	Korea	Pakistan	Russia	Turkey
Brazil	Czech Republic	Indonesia	Malaysia	Peru	South Africa	Venezuela
Chile	Egypt	Israel	Mexico	Philippines	Taiwan	
China	Hungary	Jordan	Morocco	Poland	Thailand	

An independent group of country specialists employed by Capital International Perspectives S.A. in Geneva is responsible for the composition. This group regularly monitors the index constituents and adds or deletes companies to maintain a representative sample. The index attempts to provide a representation of the industry compositions of the local markets covered and includes a representative sampling of large, medium and small capitalization companies. The index is market -value-weighted and calculated both with net and gross dividends reinvested.

Lehman Global Treasury and other Government Related Securities Index – Short and Intermediate/Long Term Government Bond Index

This index is a combination of Lehman Global Treasury and Lehman Government Related Securities Indices and tracks local and foreign currency sovereign debt and other government-related securities such as supranational and agency bonds. This composite index was created to better reflect the opportunity set in this space beyond that of Global Treasuries. It includes U.S., Pan-European, Asia-Pacific and investment grade emerging market debt. The maturity ranges of these indices are broad and customizable, but for purposes of this particular case, this index is broken down into the following maturity ranges: 1-3 years, which represent the short portion of the index; and 3+ years, which represent securities with intermediate/long maturities.

Lehman Global Aggregate Corporate Securities Index – Short and Intermediate/Long Term Corporate Bond Index

This index tracks the local and foreign currency investment grade corporate debt of more than 15 countries deno minated in 6 currencies. It includes U.S., Pan-European, Asia-Pacific and emerging market corporate debt. The maturity ranges of these indices are broad and customizable, but for purposes of this particular case, this index is broken down into the followin g maturity ranges: 1-3 years, which represent the short portion of the index; and 3+ years, which represent securities with intermediate/long maturities.

Lehman Global Inflation-Linked Index

The Global Inflation-Linked Index includes securities whose principal and income components are linked to an underlying inflation index. All the securities included in this index are issued by an investment grade sovereign in its local currency. Unlike most other fixed income indices that have a large number of constituents, this index is made up of only 78 securities spanning the maturity range. The small number of index constituents is due to the fact that it is a relatively new asset class.

FTSE Global ERPA/NAREIT Index – REIT Index (Used as a proxy for this asset class)

The FTSE Global EPRA/NAREIT Real Estate Index is desi gned to track the performance of publicly listed Real Estate Investment Trusts (REITS) and related securities worldwide. Since an index for privately held real estate investments is not available, we are using this benchmark as a proxy for global real estate to illustrate the corresponding characteristics of this segment of the market. It is important to note that this index generally tends to have higher volatility compared to a strategy consisting of privately held real estate investments.

Merrill Lynch Global Government Bond Index -Global Government Bond Index

This index is shown in this report to show an alternative Global Government Bond index that has longer than 10 years of track record. This index's constituents are government issued fixed interest bonds denominated in the issuer's local currency. The bonds are rated investment grade or above with at least one year maturity.

Citigroup Three-Month U.S. Treasury Bills -Cash and Enhanced Cash Index

The Citigroup 3-Month Treasury Bill Index is a monthly return equivalent of yield averages which are not marked to market. The calculation methodology is as follows:

- 1. Obtain discount yields for current month-end and two previous month-end dates. For example the January return requires the rates at the end of January, December and November.
- 2. Convert the discount rates to bond -equivalent yields.
- 3. Compute the simple average of the bond-equivalent yields.
- 4. Decompound to a monthly frequency using the actual number of days in the month in a 365-day year.

LIBOR Three-Month-Cash and Enhanced Cash Index

LIBOR (London Inter -Bank Offered Rate) is based on rates that contributor banks in London offer each other for inter -bank deposits. This index is LIBOR for a 3 month deposit in U.S. Dollars during a given month.

X. Discount Rate and Duration Calculation

Discount Rate Calculation

An exercise is performed considering a benefit cash flow is due in a particular year and is assumed to be settled by investing in the zero coupon bond that matures in the same year. The amount invested equals the present value of benefit cash flow, discounted at the corresponding spot rate from a AA corporate yield curve. The basis for the discount rate is the equivalent level rate that discounts the benefit cash flow to the same present value.

Example of the discounting exercise where the equivalent level rate equaled 5.65%

			Single Rate
Mid-Point of	Discount Curve	Discounted Cash	Discounted Cash
Measurement Year	Spot Rates	Flows	Flows
3/31/05	2.33%	8,773,569	8,634,346
3/31/06	2.77%	8,638,771	8,287,544
3/31/07	3.16%	8,326,716	7,844,189
3/31/08	3.50%	8,312,539	7,733,909
3/31/09	3.84%	8,335,893	7,710,580
3/31/10	4.11%	8,311,896	7,667,615
3/31/11	4.34%	8,248,766	7,607,180
3/31/30	6.02%	3,973,528	4,337,561
3/31/31	5.99%	3,667,724	3,989,048
3/31/32	5.96%	3,458,500	3,748,089
3/31/33	5.94%	3,212,136	3,469,324
3/31/34	5.92%	24,811,883	26,714,853
	Total	220,002,578	220,002,578

Strategic Asset Allocation Analysis

Duration Calculation

The duration calculation is a direct application of the Macauley formula.

The Macaulay duration is the average time it takes to pay benefits, weighting each payment by the discounted value of the benefit paid at that time. The formula used in the exercise is as follows:

$$D_{Macaulay} = \frac{\sum (t - .5)C_{t}(1+i)^{-t}}{\sum C_{t}(1+i)^{-t}}$$

C _t = cash flow in year t i = interest rate

The **modified** duration is the Macaulay duration divided by (1+i). It measures the percentage change in the liability in response to a change in interest rates of 1 percentage point.

The equivalent single discount rate was selected for the calculation of duration. All other things being equal, the duration will increase as interest rates decline.

XI. Proposed Implementation Strategy

FUND X

		Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 5
	Current					
Global Equity	0 %	5 %	10%	15%	20%	25%
Gbl Gov't Bonds - Short/Intermediate	66%	66%	57%	42%	30%	20%
Gbl Gov't Bonds - Long	0 %	0 %	0%	0%	0%	0%
Gbl Corp Bonds - Short/Intermediate	0 %	5 %	10%	15%	20%	25%
Gbl Corp Bonds - Long	0 %	5 %	10%	15%	17%	17%
Gbl Inflation Indexed Bonds	4 %	9%	13%	13%	13%	13%
Sbl Cash/Enhanced Cash	30%	10%	0%	0%	0 %	0 %
Sbl Private Equity	0 %	0%	0%	0%	0 %	0 %
Gbl Real Estate	0 %	0%	0%	0%	0 %	0%
Gbl Infrastructure	0%	0 %	0%	0%	0 %	0 %
Gbl Absolute Return/Opportunistic	0 %	0%	0%	0%	0%	0%
	100%	100%	100%	100%	100%	100%
TVOCURE REGIRES						
EXPOURE DESIRED	2.27		500	E 24		5%
Global Equity	0 %	5 %	5 %	5 %	5 %	
Gbl Gov't Bonds - Short/Intermediate	0 %	0 %	0 %	0 %	0 %	0 %
Gbl Gov't Bonds - Long	0 %	0 %	0 %	0 %	0 %	0 %
Gbl Corp Bonds - Short/Intermediate	0 %	5 %	5 %	5%	5 %	5 %
Gbl Corp Bonds - Long	0 %	5 %	5 %	5 %	2 %	0 %
Gbl Inflation Indexed Bonds	0 %	5 %	4 %	0 %	0%	0 %
Gbl Cash/Enhanced Cash	0 %	0 %	0 %	0%	0 %	0 %
Gbl Private Equity	0 %	0 %	0%	0%	0 %	0 %
Gbl Real Estate	0 %	0 %	0%	0%	0 %	0 %
GbI Infrastructure	0 %	0 %	0 %	0 %	0 %	0 %
Gbl Absolute Return/Opportunistic	0 %	0 %	0 %	0%	0 %	0 %
Out of Cash	0%	20%	10%	0%	0 %	0%
Out of Gbl Gov't Bonds - Short/Intermediate	0 %	0 %	9%	15%	12%	10%
GLOBAL EQUITY	0 %	5%	10%	15%	20%	25%
GLOBAL FIXED INCOME	100%	95%	90%	85%	80%	75%
GLOBAL ALTERNATIVES	0%	0%	0%	0%	0 %	0%

	Quarter 6 - Stage 1	Quarter 7 - Stage 2 Starts	Quarter 8	Quarter 9	Quarter 10 - Transition Completed	OBJECTIVE Recommendation
Global Equity	25%	25%	25%	25%	25%	25%
Gbl Gov't Bonds - Short/Intermediate	15%	10%	7%	5%	0%	0%
Gbl Gov't Bonds - Long	0%	0%	0%	0%	0%	0%
Gbl Corp Bonds - Short/Intermediate	30%	30%	30%	30%	30%	30%
Gbl Corp Bonds - Long	17%	17%	17%	17%	17%	17%
Gbl Inflation Indexed Bonds	13%	13%	13%	13%	13%	13%
Gbl Cash/Enhanced Cash	0%	0 %	0%	0 %	0%	0%
Gbl Private Equity	0%	0 %	0%	0 %	5%	5%
Gbl Real Estate	0%	0 %	3%	3 %	3%	3%
Gbl Infrastructure	0%	0 %	0 %	2 %	2%	2%
Gbl Absolute Return/Opportunistic	0%	5%	5%	5%	5%	5%
	100%	100%	100%	100%	100%	100%
EXPOURE DESIRED						
Global Equity	0%	0 %	0%	0%	0 %	0%
Gbl Gov't Bonds - Short/Intermediate	0 %	0 %	0%	0%	0 %	0%
Gbl Gov't Bonds - Long	0 %	0 %	0 %	0%	0 %	0%
Gbl Corp Bonds - Short/Intermediate	5%	0 %	0%	0%	0%	0%
Gbl Corp Bonds - Long	0%	0 %	0%	0%	0 %	0%
3bi Inflation Indexed Bonds	0%	0 %	0%	0%	0%	0%
Gbl Cash/Enhanced Cash	0%	0 %	0%	0%	0%	0%
Gbl Private Equity	0 %	0 %	0 %	0%	5%	0%
Gbl Real Estate	0%	0 %	3 %	0 %	0 %	0%
3bl Infrastructure	0%	0 %	0 %	2 %	0%	0%
Gbl Absolute Return/Opportunistic	0%	5 %	0 %	0%	0%	0%
Out of Cash	0%	0 %	0%	0%	0%	0%
Out of Gbl Gov't Bonds - Short/Intermediate	5%	5 %	3 %	2%	5%	0%
GLOBAL EQUITY	25%	25%	25%	25%	25%	25%
GLOBAL FIXED INCOME	75%	70%	67%	65%	60%	60%
GLOBAL ALTERNATIVES	0%	5%	8 %	10%	15%	15%

Strategic Asset Allocation Analysis

FUND Y (Maintains Current Policy)

		Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 5
	Current					
Global Equity	0%	5 %	10%	15%	20%	25%
Gbl Gov't Bonds - Short/Intermediate	66%	66%	66%	52%	37%	22%
Gbl Gov't Bonds - Long	0%	5 %	10%	15%	20%	25%
Gbl Corp Bonds - Short/Intermediate	0%	0 %	0 %	0%	0%	0 %
Gbl Corp Bonds - Long	0%	0 %	0 %	0%	0 %	0 %
Gbl Inflation Indexed Bonds	3%	8 %	13%	18%	23%	28%
Gbl Cash/Enhanced Cash	31%	16%	1 %	0%	0 %	0 %
GbI Private Equity	0%	0%	0 %	0%	0%	0 %
Gbl Real Estate	0%	0 %	0 %	0 %	0 %	0 %
Gbl Infrastructure	0%	0 %	0 %	0 %	0%	0 %
Gbl Absolute Return/Opportunistic	0%	0 %	0 %	0 %	0 %	0 %
	100%	100%	100%	100%	100%	100%
EXPOURE DESIRED						
Global Equity	0 %	5 %	5 %	5%	5 %	5 %
Gbl Gov't Bonds - Short/Intermediate	0%	0 %	0%	0 %	0%	0%
Gbl Gov't Bonds - Long	0%	5 %	5%	5 %	5%	5%
Gbl Corp Bonds - Short/Intermediate	0%	0 %	0%	0%	0%	0 %
Gbl Corp Bonds - Long	0%	0%	0 %	0%	0%	0 %
Gbl Inflation Indexed Bonds	0%	5 %	5 %	5%	5%	5%
Gbl Cash/Enhanced Cash	0%	0 %	0%	0%	0%	0%
Gbl Private Equity	0 %	0 %	0%	0 %	0 %	0 %
Gbl Real Estate	0%	0 %	0 %	0%	0%	0%
GbI Infrastructure	0%	0 %	0%	0%	0%	0%
Gbi Absolute Return/Opportunistic	0%	0%	0 %	0 %	0 %	0 %
Out of Cash	0%	15%	15%	1 %	0%	0%
Out of Gbl Gov't Bonds - Short/Intermediate	0%	0%	0 %	15%	15%	15%
GLOBAL EQUITY	0%	5 %	10%	15%	20%	25%
GLOBAL FIXED INCOME	100%	95%	90%	85%	80%	75%
GLOBAL ALTERNATIVES	0%	0%	0 %	0%	0%	0%
Boroon const						
■ GLOBAL EQUITY						
■ GLOBAL FIXED INCOME						
■GLOBAL ALTERNATIVES						

		Quarter 8	Quarter 9	Quarter 10 - Transition Completed	OBJECTIVE Recommendation
25%	25%	25%	25%	25%	25%
15%	12%	7%	5%	0%	0%
30%	30%				30%
0%	0 %	0%	0%	0 %	0%
0%	0 %	0%	0 %	0 %	0%
30%	30%	30%	30%	30%	30%
0%	0 %	0 %	0%	0%	0%
0%	0 %	0%	0%	5%	5%
0%	0 %	5%	5%	5%	5%
0%	0 %	0%	2%	2%	2%
0%	3 %	3%	3%	3 %	3%
100%	100%	100%	100%	100%	100%
0 %	0 %	0 %	0 %	0 %	0%
0%	0 %	0%	0%	0 %	0%
5%	0 %	0%	0%	0%	0%
0%	0 %	0%	0%		0%
0%	0 %	0%	0%	0%	0%
2%	0 %	0%	0%	0%	0%
0%	0%	0%	0%	0%	0%
0%	0%	0%	0%	5%	0%
0%	0%	5 %	0%	0 %	0%
0%	0 %	0 %	2%	0 %	0%
0%	3 %	0%	0 %	0%	0%
0%	0%	0%	0%	0%	0%
7 %	3 %	5 %	2 %	5%	0%
25%	25%	25%	25%	25%	25%
					60%
0%	3 %	8%	10%	15%	15%
	30% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0	30% 30% 30% 0 % 0 % 0 % 0 % 0 % 0 % 0 %	30% 30% 30% 30% 30% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0	30% 30% 30% 30% 30% 30% 30% 30% 0% 0% 0% 0% 0% 0% 0% 30% 3	30% 30% 30% 30% 30% 30% 30% 30% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0% 30% 3

Strategic Asset Allocation Analysis

FUND Y (Relaxes Current Policy)

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 5	Quarter 6 - Stage 1	Quarter 7
Current							
0%	5 %	10%	15%	20%	25%	30%	35%
							30%
							0%
0%	5%	10%	15%	20%		30%	35%
0%	0 %	0%	0 %	0%		0%	0 %
	3 %		3 %	3%	0%	0%	0 %
31%	21%	11%	1%	0%	0%	0%	0 %
0%	0%	0%	0%	0%	0%	0%	0%
						0%	0 %
0%	0%	0%	0 %	0%	0 %	0%	0%
0%	0%	0%	0 %	0%	0%	0%	0%
100%	100%	100%	100%	100%	100%	100%	100%
004	£ %	EN	E 94	EM	E 04	604	5%
							0%
							0%
	0 %						5%
							0%
							0%
0%	0%	0%		0%		0%	0%
							0%
							0%
	0 %	0%	0 %		0 %		0%
0%	0%	0%	0%	0%	0%	0%	0%
0%	10%	10%	10%	1%	0%	0%	0%
0%		0%	9 %	9%	7%		10%
0%	0%	0%	0%	3%	3%	0%	0%
0%	5%	10%	15%	20%	25%	30%	35%
					75%	70%	65%
0%	0%	0%	0%	0%	0 %	0%	0%
	68% ON O	66% 66% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0%	66% 66% 66% 66% 66% 66% 66% 66% 66% 66%	66% 66% 66% 66% 66% 66% 66% 66% 66% 66%	66% 66% 66% 67% 67% 57% 66% 67% 67% 67% 67% 67% 67% 67% 67% 6	66% 66% 66% 57% 50% 50% 50% 50% 50% 50% 50% 50% 50% 50	66% 66% 66% 66% 57% 57% 50% 40% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0

	Quarter 8	Quarter 9	Quarter 10 -Stage 1	Quarter 11 - Stage 2 Starts	Quarter 12	Quarter 13 - Transition Completed	OBJECTIVE
							Recommendation
Global Equity	40%	45%	50%	50%	50%	50%	50%
3bl Gov't Bonds - Short/Intermediate	25%	20%	15%	10%	5%	0%	0%
Gbl Gov't Bonds - Long	0%	0%	0%	0%	0%	0%	0%
bl Corp Bonds - Short/Intermediate	35%	35%	35%	35%	35%	35%	35%
ibl Corp Bonds - Long ibl Inflation Indexed Bonds	0%	0%	0%	0%	0%	0%	0% 0%
	0%	0%	0%	0%	0 %	0%	0%
bl Cash/Enhanced Cash	0%	0%	0%	0%	0%	0 % 5 %	
bl Private Equity							5%
bl Real Estate	0%	0%	0%	0%	5 %	5%	5% 0%
	0%	0%	0%	0%	0 % 5 %	0 % 5 %	5%
Gbl Absolute Return/Opportunistic	100%	100%	100%	100%	100%	100%	100%
	100%	100%	100%	100%	100%	100%	100%
XPOURE DESIRED	5%	5%	5%	0%	0%	0%	
lobal Equity ibl Gov't Bonds - Short/Intermediate			0%	0%	0%	0%	0%
	0%	0%					0%
bl Gov't Bonds - Long	0%	0%	0%	0%	0%	0%	0%
bl Corp Bonds - Short/Intermediate bl Corp Bonds - Long	0%	0%	0%	0%	0%	0%	0% 0%
ibl Inflation Indexed Bonds	0%	0%	0%	0%	0%	0%	0%
ibl Cash/Enhanced Cash	0%	0%	0%	0%	0%	0%	016
bi Private Equity	0%	0%	0%	0%	0%	5%	0%
bi Real Estate	0%	0%	0%	0%	5%	0%	0%
ibl Infrastructure	0%	0%	0%	0%	0%	0%	0%
ibl Absolute Return/Opportunistic	0%	0%	0%	5%	0%	0%	0%
out of Cash	0%	0%	0%	0%	0%	0%	0%
ut of Gbl Gov't Bonds - Short/Intermediate	5%	5%	5%	5%	5%	5%	100%
ut of Inflation Indexed Bonds	0%	0%	0%	0%	0%	0%	
LOBAL EQUITY	40%	45%	50%	50%	50%	50%	50%
LOBAL FIXED INCOME	60%	55%	50%	45%	40%	35%	35%
SLOBAL ALTERNATIVES	0%	0%	0%	5%	10%	15%	15%
_							
SLOBAL EQUITY							
GLOBAL FIXED INCOME							
GLOBAL ALTERNATIVES.							

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