Finance Science, Financial Innovation and Long-Term Asset Management

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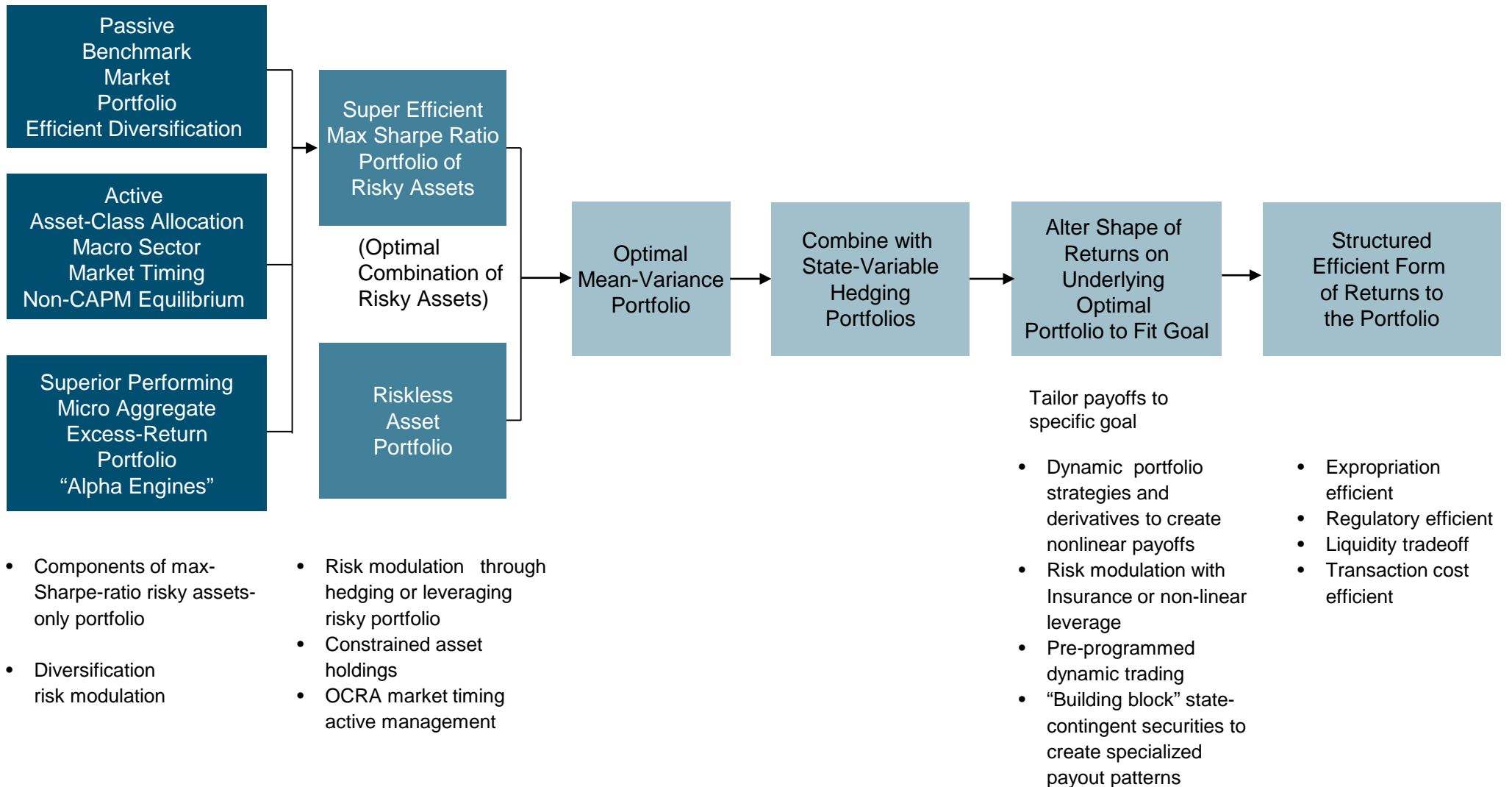
New Developments in Long-Term Asset Management

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Domain of Investment Management

Stages of production process for a specified investment goal

Passive **Benchmark** **Market** **Portfolio** **Efficient Diversification**	**Super Efficient** **Max Sharpe Ratio** **Portfolio of** **Risky Assets** (Optimal Combination of Risky Assets)	Optimal Mean-Variance Portfolio	Combine with State-Variable Hedging Portfolios	Alter Shape of Returns on Underlying Optimal Portfolio to Fit Goal	Structured Efficient Form of Returns to the Portfolio
Active **Asset-Class Allocation** **Macro Sector** **Market Timing** **Non-CAPM Equilibrium**					
Superior Performing **Micro Aggregate** **Excess-Return** **Portfolio** **"Alpha Engines"**	**Riskless** **Asset** **Portfolio**				

- Components of max-Sharpe-ratio risky assets-only portfolio

- Diversification risk modulation

- Risk modulation through hedging or leveraging risky portfolio
- Constrained asset holdings
- OCRA market timing active management

Tailor payoffs to specific goal

- Dynamic portfolio strategies and derivatives to create nonlinear payoffs
- Risk modulation with Insurance or non-linear leverage
- Pre-programmed dynamic trading
- "Building block" state-contingent securities to create specialized payout patterns

- Expropriation efficient
- Regulatory efficient
- Liquidity tradeoff
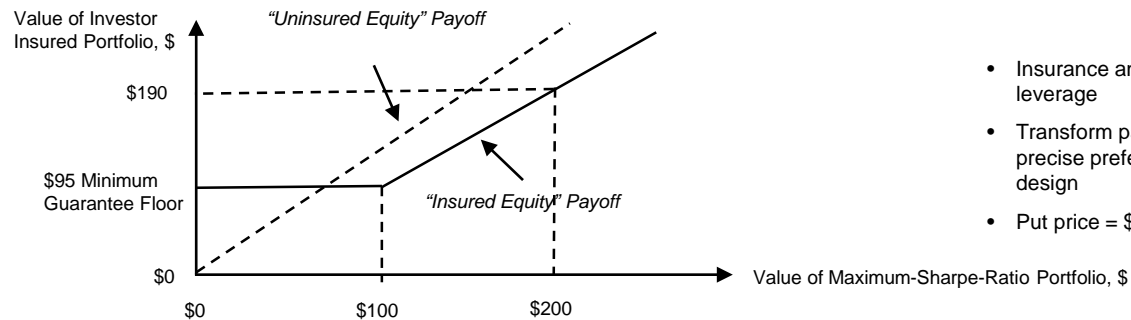- Transaction cost efficient

Goal-Based Investment Strategies Improve Performance Transform Shape of OCRA Payoffs to Fit the Goal

Dynamic portfolio strategies and derivatives tailored to improve performance of achieving the goal
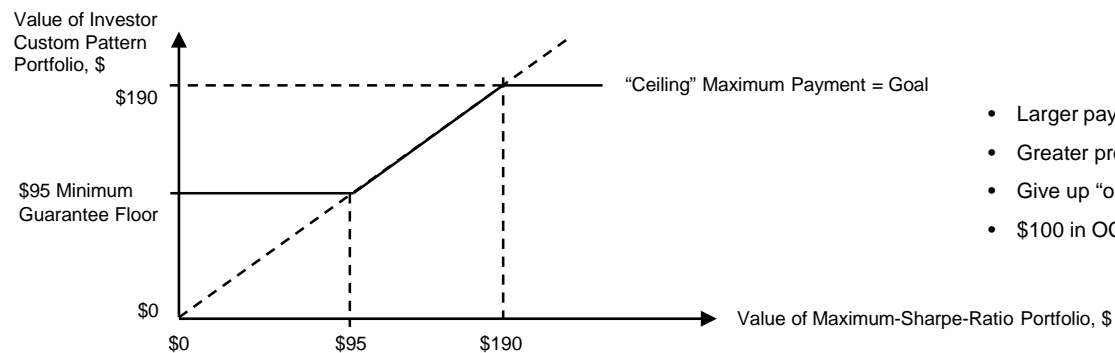
UNLIMITED UPSIDE WITH GUARANTEED MINIMUM

Value of Investor Insured Portfolio, $

"Uninsured Equity" Payoff

$190

$95 Minimum Guarantee Floor

"Insured Equity" Payoff

$0

$0 $100 $200

Value of Maximum-Sharpe-Ratio Portfolio, $

- Insurance and non-linear leverage
- Transform payoff patterns to fit precise preference custom design
- Put price = $5 $95 in OCRA

Three Ways to Manage Risk
Diversification
Hedging
Insurance

Diversification and hedging are "free"
Insurance must pay a premium

IMPROVE GOAL ACHIEVEMENT WITH GUARANTEED MINIMUM AND CAPPED MAXIMUM EQUAL TO THE GOAL

Value of Investor Custom Pattern Portfolio, $

$190

"Ceiling" Maximum Payment = Goal

$95 Minimum Guarantee Floor

$0

$0 $95 $190

Value of Maximum-Sharpe-Ratio Portfolio, $

- Larger pay-out between minimum and the goal
- Greater probability of achieving the goal
- Give up "or more"—sell call for $5
- $100 in OCRA

Long-Term Investing: Lifecycle Retirement Funding Optimal Allocation Requires Integration of All Sources

Create a personal risk balance sheet for each participant that integrates all dedicated funding sources of retirement income.

Assets	Liabilities
Government Minimum Pension	Minimum-Income Goal
Occupational Defined-Benefit Pension Plan	Surplus Available for Desired-Income Goal
Defined-Contribution Balance	
Projected Future Contributions ("Human Capital")	
Reverse Mortgage Potential	

Long-Term Investing: Multi-Generation Lifecycle Funding & Risk Transfer Integrated Asset/Liability Mgt. Government Risk Balance Sheet

Determining the goal and investment strategy for a sovereign wealth fund

Assets	
	$ Bn
Present Value of Incomes from:	
TAXES	**1130.7**
Income	573.6
Assets	83.7
Customs	1.1
Excise & GST	220.4
Motor Vehicles	80.9
Others-Tax	171.0
FEES	**84.8**
Sales of Goods	4.9
Rental	26.4
All other Fees	53.5
SEIGNORAGE	**TBD**
Balances of:	
INVESTMENTS	**688.0**
Pension Fund	160.0
Wealth Fund	528.0
CASH	**112.3**
INFRASTRUCTURE	**TBD**
Government-owned Enterprises	**TBD**
CURRENCY RESERVES	**204.0**
REAL ESTATE	**TBD**
OTHER ASSETS	**6.0**
TOTAL	**2225.7**

Liabilities	
	$ Bn
Present Value of Non Discretionary Expenses on:	
SOCIAL DEVELOPMENT	**653.0**
SECURITY & EXTERNAL RELATIONS	**600.6**
ECONOMIC DEVELOPMENT	**193.4**
GOVERNMENT ADMINISTRATION	**70.7**
Balances of:	
MONETARY BASE	**TBD**
GOVERNMENT DEBT OUTSTANDING	**TBD**
Foreign Currency	
Local Currency	
PENSION LIABILITIES	**TBD**
Contingent Claims (Implicit Guarantees)	
GUARANTEES TO BANKS AND NON-BANKS	**TBD**
GUARANTEES ON RETIREMENT INCOME	**TBD**
GUARANTEES ON SOCIAL WELFARE	**TBD**
General Balance	
(Economic Assets in excess of Economic Liabil	708.1
TOTAL	**2225.7**

Note: Economic Balance Sheet integrates central bank

Integrated Endowment Management: Risk Balance Sheet University

• Tuition Undergraduate	• Salaries Tenure Faculty
• Tuition Executive Education	• Financial Aid
• Endowment	• Energy
• Alumni Gifts	• Forward Tuition Contracts
• Grants	• Debt
• Sponsored Research	• Other Liabilities
• Publishing	
• Real Estate: Commercial	
• Real Estate: Residential	
• Patents	• Net Worth

Defining and Constructing the Risk-Free Asset

- Define the "technical" risk-free asset to be the asset whose return over the shortest feasible trading interval is known for certain. It is universal for all portfolios without regard to their goals.

- Define the "numeraire" risk-free asset" to be the lowest-cost asset that provides all the payments of the portfolio goal with certainty. It is specific to the goal of the portfolio and it has the advantage that if taken as numeraire, the risk-free interest rate is a constant, 0%.

- Define a "risky asset": all assets that are not the risk-free asset are risky assets. Thus the risk-free asset determines what is risky.

- The risk-free asset is well-defined whether or not it actually exists in the market and is traded.

- When the risk-free asset is not available, a "surrogate risk-free asset" is created, which functions as the risk-free asset for actual implementation, including asset allocation, pricing and risk measurement.

- The goal for the portfolio determines the numeraire risk-free asset and therefore defines the appropriate reference measure of risk. Thus, if an incorrect-for-the-goal risk-free asset is used, the risk of the portfolio will not be measured correctly. If the risk of the portfolio is not measured properly, then it is not possible to manage the risk of the portfolio well.

- The "funded ratio" is defined as the current value of the portfolio divided by the current value of the promised payments of the goal. It measures "closeness to the goal" as the fraction of the goal payments which can be funded by the portfolio.

Wrong Risk-Free Asset: Retirement Funding Has an Income Goal But Traditional DC Investing Focuses on Wealth Accumulation

Risk-free asset: inflation-protected deferred annuity with payouts equal to targeted income for retirement (Funded ratio = 1.00) monthly returns, if marked to market

High risk in wealth terms, minimum risk in income terms

DEFERRED ANNUITY(USD)

DEFERRED ANNUITY(FUNDED-RATIO UNITS)
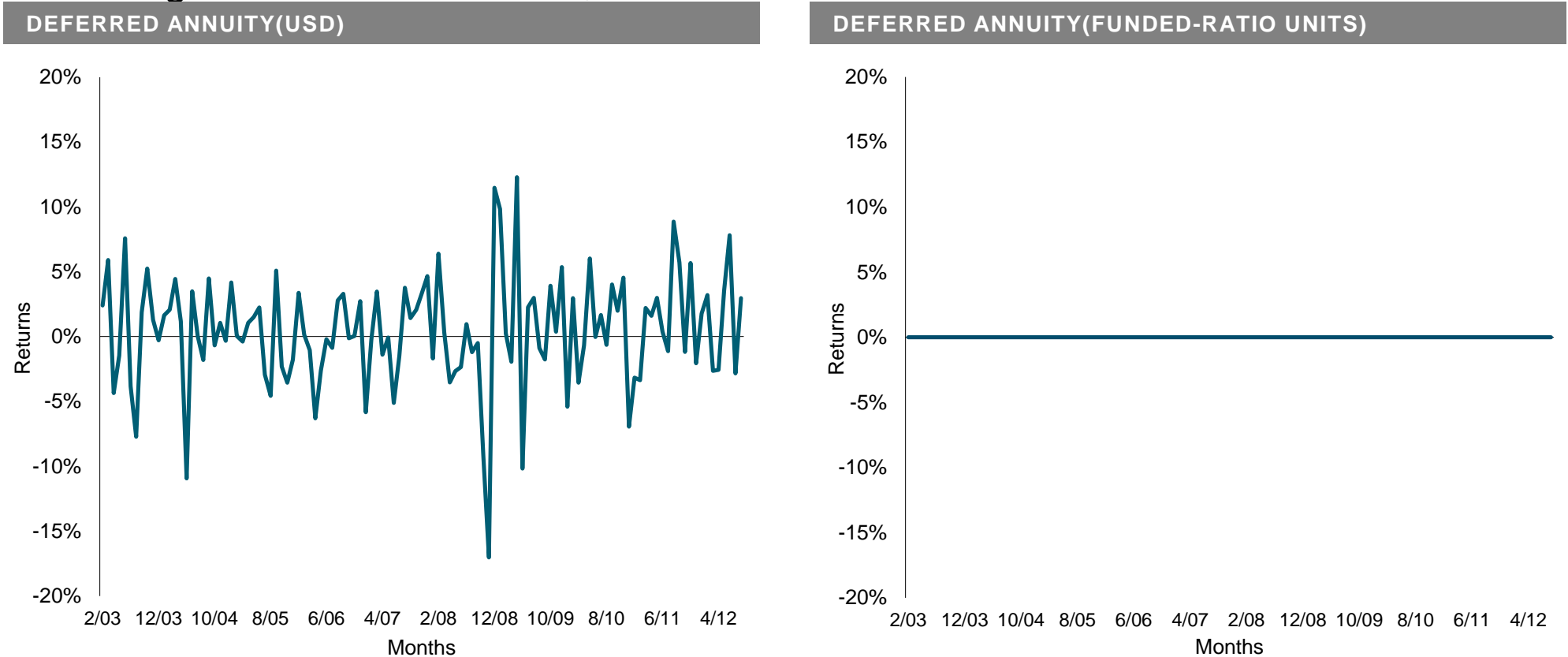
The volatility of annuity price is high risk when measured in terms of asset value.

The volatility of annuity price is minimum risk when measured in terms of income (funded-ratio units).

Wrong Risk-Free Asset: Retirement Funding Has an Income Goal But Traditional DC Investing Focuses on Wealth Accumulation

90-day US T-bill monthly returns: Risk-free asset for wealth preservation

Wealth preservation goal is inconsistent with income preservation goal: cannot satisfy both

3-MONTH US T-BILL (USD)

3-MONTH US T-BILL (FUNDED-RATIO UNITS)
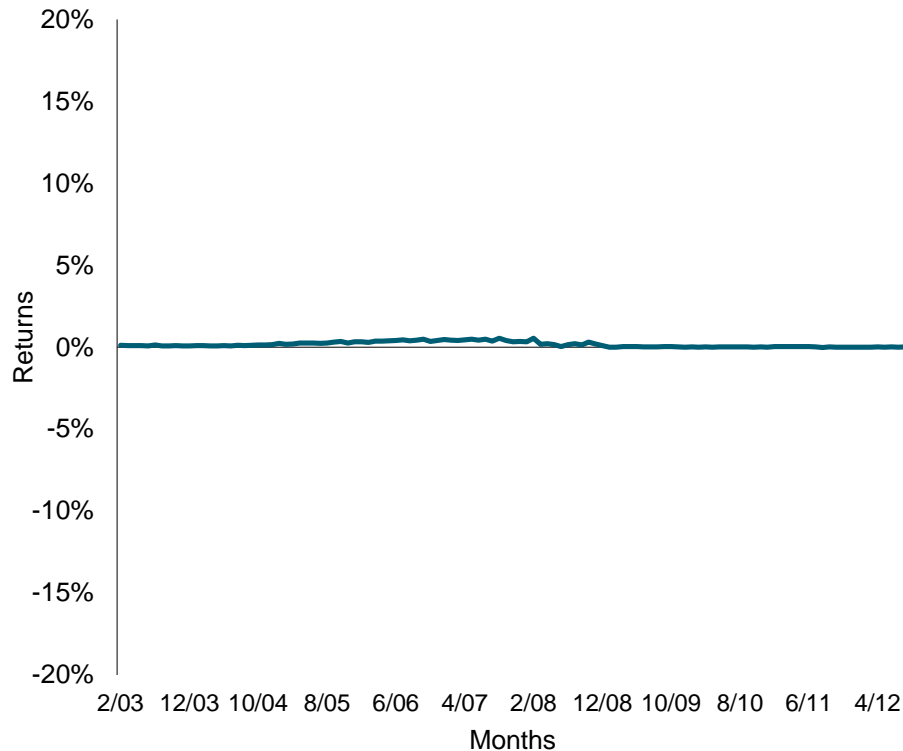
The volatility of T-bills is minimum risk when measured in terms of asset value change
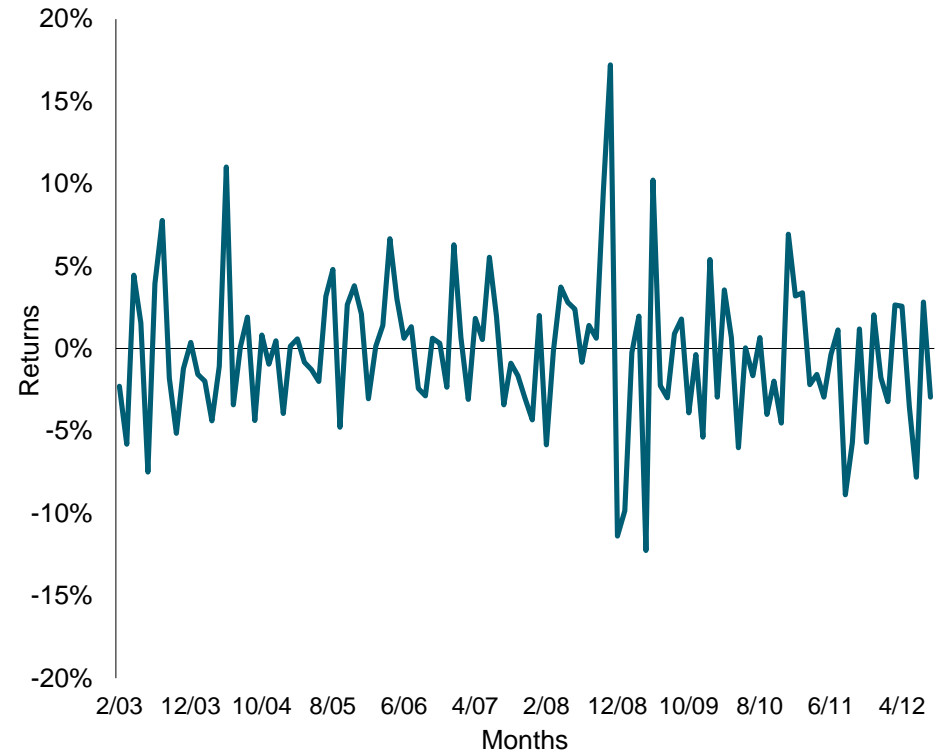
The volatility of T-bills is high risk when measured in terms of income (funded-ratio units) change

Risk & Return: Wealth vs. Income Goals Imply Different Risk-Free Assets and Different Risk Measures

Measuring the risk/return tradeoff correctly relative to the goal

US DOLLARS   WEALTH GOAL

FUNDED-RATIO INCOME UNITS   INCOME GOAL

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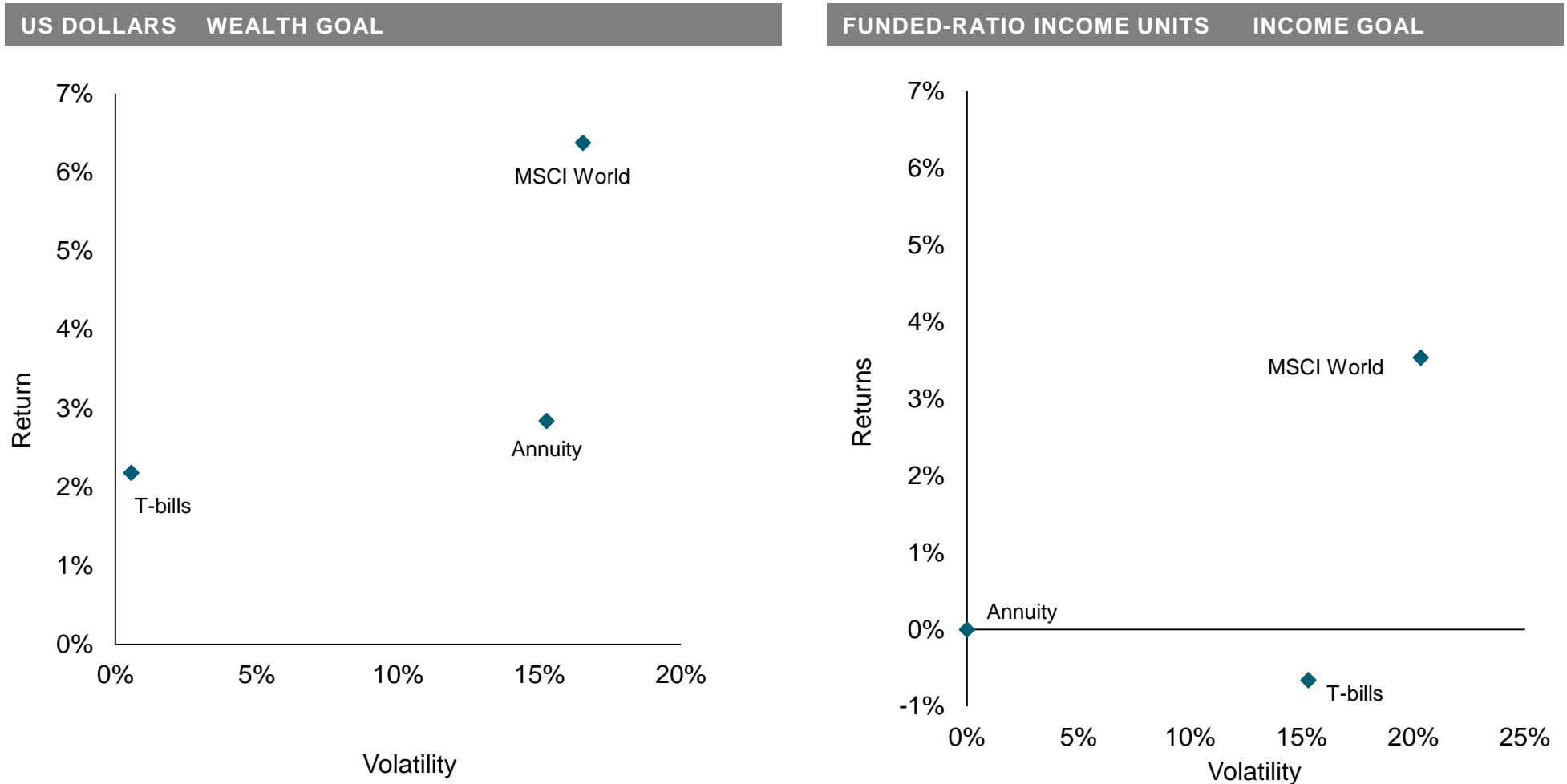
Constructing a Surrogate Risk-Free Asset

- The surrogate risk-free asset is constructed as the minimum-tracking-error portfolio of available assets, combined with adequate reserves to ensure the promised payments can be made, within a specified probability limit and without unacceptable tail risk.

- Tracking error of a portfolio is defined as the discrepancy between the cumulative return on a portfolio and a benchmark portfolio. The benchmark for the surrogate risk-free asset is the risk-free asset.

- The surrogate risk-free asset is the best feasible hedging portfolio. It is also called the "immunization" portfolio, in the context of liability-driven investing (LDI) terminology.

- The "reserve" for the surrogate risk-free asset portfolio is the amount of additional funding over the price of the risk-free asset required to ensure that the portfolio can make the promised payments within the specified probability limit 1- p and without unacceptable tail risk.

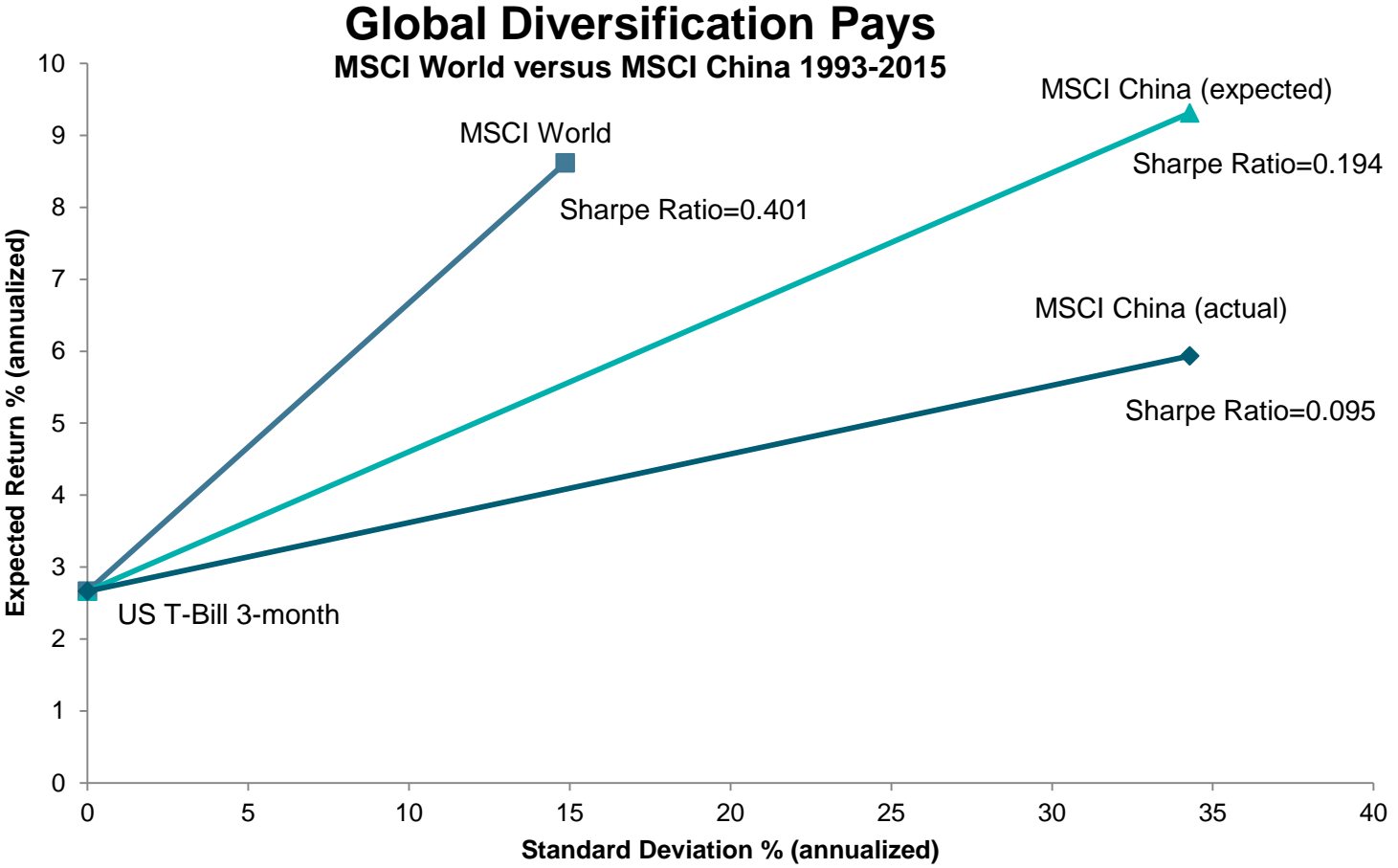# Calculating the Reserve for Tracking Error in Surrogate

Compute the Value[Income] at Risk at probability level p to determine the income amount that the surrogate risk-free asset could pay with probability 1 - p . If $V0$ is the promised income payment for the risk-free asset, then $V0 - \underline{V}(h,p)$ is the cushion or reserve

Calculating the Price of Surrogate Risk-Free Income

- If P = the price of a "true" risk-free asset for promised income and R = reserve required for the surrogate risk-free asset as percentage then the price of the surrogate risk-free asset = (1 + R) P, where R is $[V0 - \underline{V}(h,p)]/ V0$

- If, with an actual risk-free asset, the amount of promised income that one could buy = Y , then the amount of promised income that one could buy with the surrogate risk-free asset = Y/[1 + R]

- R will depend on the tracking error distribution, the specified probability p and the time horizon until the promised payment is due.

- Although the reserve will be different for different situations, the term "[surrogate] risk-free asset value will be the same for all situations: the promised payment will be made with probability 1 – p, which facilitates communication across people and over time.

- The surrogate-risk-free-asset reserve calculation is used to increase the price of the risk-free [for the goal] asset to reflect the additional amount needed to ensure the risk-free surrogate can pay what is promised. Thus, the "funded ratio" of the portfolio when there is a surrogate risk-free asset will be 1/(1+R) of the funded ratio if there was an actual risk-free asset available.

Capital-Controls Stabilization, Governance and Local Investment Government Policies Have "Side-Effect" Cost of Inefficient Diversification

Cost of Restricting Investing and Risk-Bearing to Domestic Holders Can be Substantial – China

Global Diversification Pays
MSCI World versus MSCI China 1993-2015

- MSCI World — Sharpe Ratio=0.401
- MSCI China (expected) — Sharpe Ratio=0.194
- MSCI China (actual) — Sharpe Ratio=0.095
- US T-Bill 3-month

Axis labels: Expected Return % (annualized); Standard Deviation % (annualized)

Financial Innovation Can Create Improved Policy-Objectives Implementation without the Unintended Cost of Inefficient Risk Diversification by Separating Risk Flows from Capital Flows, Investment and Governance

Before: China SWF/ Pension Fund 100% invested in China A Share stocks

China SWF/Pension Fund Return = Return on Chinese A Share stocks
Concentrated Equity Risk

Enter into a Total-Return Swap contract where SWF/Pension Fund

Pays: Return on Chinese A Share stocks

Receives: Return on World stocks

After: Still 100% invested in China stocks as policy requires + swap contract which provides the efficient diversification

China SWF/Pension Fund Return = Return World stocks

Well-Diversified Equity Risk

Note: China only has a cash outflow from the swap when China market outperforms the world markets which are "good times" for China and no need for capital-flight controls and actually receives cash inflow in "bad times". Non-Chinese counterparty gets efficient exposure to China A Shares from a credit-secure counterparty in size. May also help mitigate "asset bubble" risk in local market.

Relative Advantage of Country Swaps for Diversifying Risk

- *Lower Cost of Capital* through increased global risk-bearing of local risks

- *Always Natural Counterparties Available*: if a country has "too much" exposure to itself for efficient diversification, the rest of the world has "too little" exposure to that country.

- *Implementation:* Transact directly among sovereign wealth funds, government pension funds, reserves, and central banks, with no need to involve intermediary cost and credit risk. These institutions can in turn supply global exposure locally.

- *Minimizes Moral Hazard* of expropriation, repudiation, taxes or accounting

- *Credit Risk*: no principal amounts at risk; set frequency of payments (.25, 0.5, 1.0 years); "right-way" contract [pay when country is better able]; potential for credit guarantee and/or two-way-marked-to-market collateral

- *Solution is robust*: It works, even with full capital controls

- *Solution is non-invasive*: doesn't require change in employment patterns and behavior, changes in industrial structure or changes in financial system design

- *Solution is reversible* by simply entering into an off-setting swap

- *Insurance form*: strategy can be implemented as a swaption

Long-Term Investor Opportunity: Financial Service Alpha

- Three sources of alpha: 1. *traditional alpha 2. financial-services alpha 3. dimensional alpha*

- Financial services alpha is compensation for providing intermediation services through capital markets including liquidity, reducing the costs of institutional rigidities to other institutions, expanding market completion including numeraire risk-free asset creation, and generally distributing risks to their best holders.

- Issue aggregate per capita consumption-indexed bonds, which allow the purchaser to hedge both inflation and standard-of-living change risks. Government issuers have a nearly perfect hedge of such liabilities from their VAT asset. Indeed, in the absence of reliable estimates of per capita consumption, the bonds could be linked to VAT revenues (adjusted for any change in the VAT tax rate)

- "SeLFIES" (*S*tandard of *L*iving indexed, *F*orward-starting, *I*ncome-only *S*ecurities) issuance to those in the accumulation-phase for retirement funding as the risk-free asset.

- "Perpetual" sovereign wealth funds that represent all future generations could issue SeLFies of maturities matching those needed by generations which are currently in a lifecycle pattern of accumulation and drawdown, to provide hedges for standard of living, inflation, interest rate and longevity risks and thereby transfer those risks to future generations, on their behalf, who have not yet started the lifecycle process.