

# **Observations on *the Role of Financial Innovation and Derivative Markets in Economic Growth and Development***

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# A Well-Functioning Financial System is Essential for Sustainable Economic Growth and Development: Observations from the Past and into the Future

Financial innovation drives improvement of the financial system  
Finance science, technology, and economic need drive financial innovation

- Derivative markets can efficiently redistribute risks to those who are better equipped to bear them, in a non-invasive and reversible fashion.
- Intangible derivative contracts can address very tangible challenges to economic growth and stabilization of the economy

## *Timeless historical innovation examples from a financial economist's notebook--*

- 1970s- Crisis-induced financial innovations with lasting impact on growth
  - Crisis can slow or even reverse financial innovation as in 2008-9 but it can also induce implementation of financial innovation
- 1980s- Eliminating the largest risk in banks forever
  - How the largest risk in banks was eliminated forever without disturbing how they serve their customers or increasing the costs of the services
- 1990s- Enabling economic growth by lowering energy costs with a greener solution
  - City of Leipzig : Creating a “synthetic pipeline” for a lower-cost and greener solution for a city to expand electric power capacity to grow
  - TVA : Creating synthetic power plants for more efficient energy resource use and a greener world in expanding electric power capacity for growth and development

## Major Financial and Economic Crisis 1970s: Risk Explosion and Stagflation in USA

- Multi-dimensional explosion of volatilities in the western economies reflected in financial systems
- Fall of Bretton Woods currency system
- First oil crisis in 1973-4 and a second one in 1979
- Double-digit inflation in the US, highest since Civil War
- Double-digit interest rates, highest since Civil War
- No mortgage money: Regulation Q -5% deposit interest cap
- High unemployment ~9%
- “Stagflation” unknown, and still unsolved, economic disease
- Stock market fell 50% in real terms mid 1973 – 1974
- 1973-1975 recession was really a 1970s recession because its effects extended into the 1980s

# Risk Explosion 1970s Drives an Explosion of Financial Innovation in USA--Later Adopted Throughout the World-- Finance Science and Practice Become Inexorably Linked

- Option exchange: financial value insurance
- Financial futures for currencies, interest rates, stocks
- NASDAQ , first electronic stock market
- Money market funds, high-yield and floating rate bonds
- Index funds Stage Coach Fund 1970 & Vanguard 1975
- TIAA-CREF international diversification in stocks 1972
- ERISA 1974 modern employer-funded pension system in US
- May Day 1975 permitted negotiated commissions on stock trading
- Debt securitization and creation of a national mortgage market
- Eliminate destructive regulations: deposit rate ceilings
- Foundation set for globalization of capital markets: derivative markets adopted throughout the world and global diversification
- Finance science: existing and breakthrough quantitative models and databases were essential for implementing these innovations

# How the Largest Risk in Banks was Eliminated Forever

## Interest Rate Swap (1980s)

**Before Swap: Bank lends money to customers at a fixed interest rate and provides deposits and pays interest to customers at a floating rate**

**Bank Earnings = fixed-rate paid by borrowers – floating-rate paid to its depositors**

**Bank enters into an interest-rate swap contract where it**

**Pays: a fixed-rate rate of interest**

**Receives: a floating rate of interest**

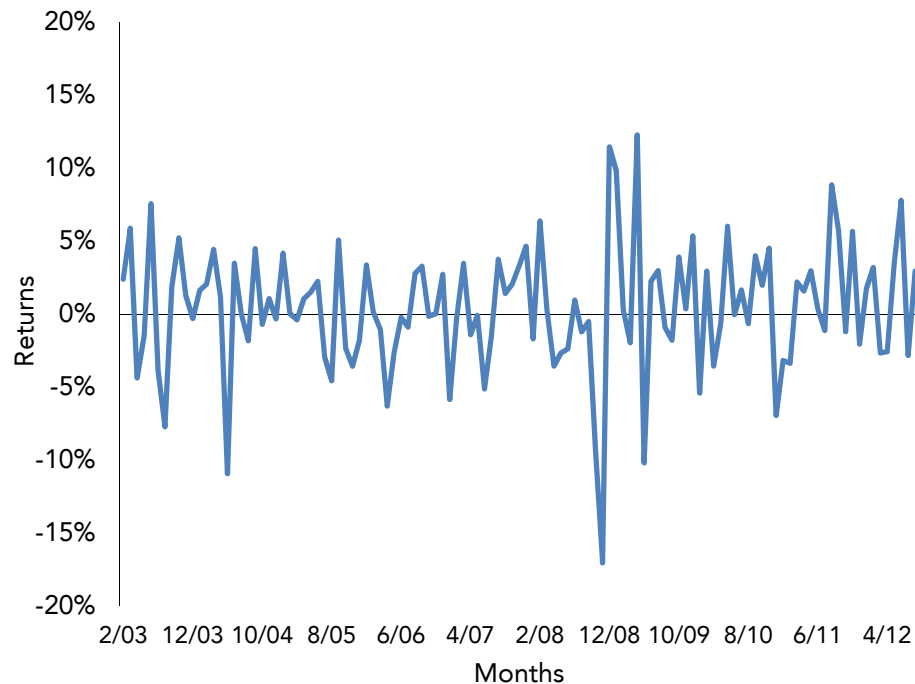
**After: Still satisfies needs of both customers + swap contract which eliminates interest rate risk**

**Bank Earnings = [fixed-rate paid by borrowers – fixed-rate swap] + [floating-rate swap – floating-rate to depositors] = payment for banking services**

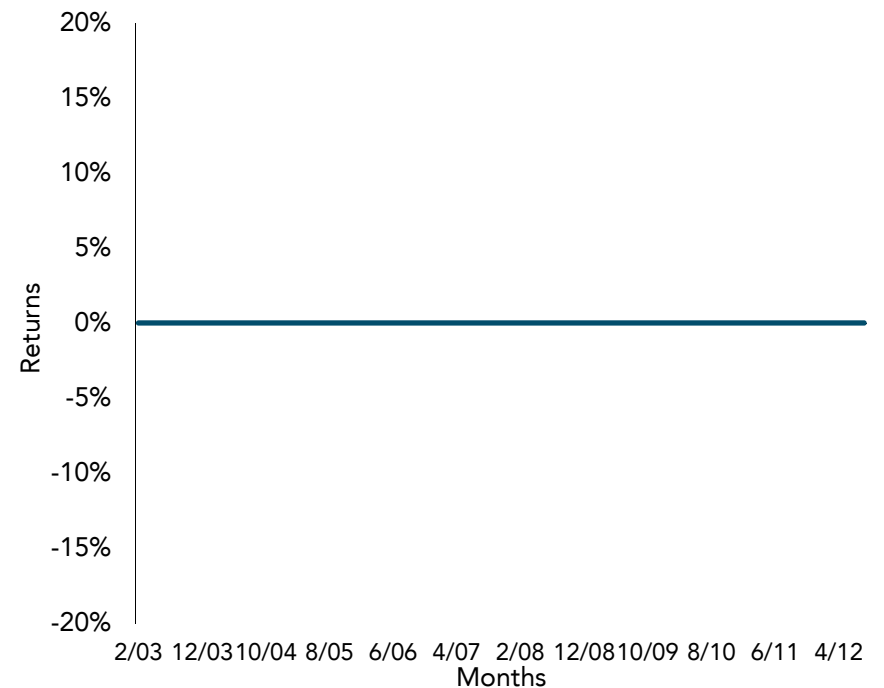
# Interest Rate Risk is No Longer a “Banking-Service” Risk

Interest Rate Swap Derivative Contract Removes Interest Rate Risk Taking for Banks in order to Service their Customers Needs

FIXED-RATE LOANS FINANCED BY FLOATING-RATE DEPOSITS



FIXED-RATE LOANS FINANCED BY FLOATING-RATE DEPOSITS PLUS AN INTEREST-RATE SWAP



# Substituting Contracts for Physical Assets to Create Greater Efficiency and a Greener World: Leipzig Gas Pipeline 1990s

German reunification in 1990 created rapid economic development and an increased power demand. To meet this demand required greater natural gas supply. Leipzig had two options:



**Option 1**

Spend **\$50M** for a pipeline to the European gas grid and buy UK, Norwegian and Dutch gas at spot prices indexed off the USD price of heating oil at the Upper Rhine delivery point

**Option 2**

Spend **\$300M** for a new pipeline to connect to the Russian gas grid and enter a 15 year fixed price contract in Deutsche Marks

# Contractual Synthesis of Assets: Leipzig Gas Pipeline

	Option 1	Option 2
<b>Capital Investment</b>	\$50M	\$300M
<b>Advantages</b>	Reduced political risk by avoiding dependence on Russians Lower capital investment	Stable prices of power potentially useful to population accustomed to price controls
<b>Disadvantages</b>	Gas price volatility	High capital investment

Option 1 could be made attractive with hedging, but had two significant problems:

1. **Limited hedge instruments available:**
  2. Crude oil call up to 5 years in USD
  3. Crude/heating oil basis swaps up to 2 years
  4. FX Options up to 5 years
  5. Currency swaps up to 10 years
  
2. **Limited sophistication of the city administration**

## Efficient and Green Solution

A bank provided a 15 year cap on European gas prices at a strike price equal to the Russian fixed price contract in exchange for a premium of \$125 MM. The cap is effectively a “synthetic pipeline”.

The price is half of the incremental cost of a physical pipeline to Russia and compensates the bank for hedge mismatches and the need to dynamically adjust hedges over 15 years.

Source: Peter Hancock, AIG, 2014



# Derivative Contracts as a Synthetic Power Plant to Create More Efficient Energy Resource Use and a Greener World

Tennessee Valley Authority (TVA) Uses Option Purchase Agreements (OPA) to Acquire Power

- In 1994, Tennessee Valley Authority, the largest public power utility in the United States, undertook a long-term strategic analysis of the energy demands of its customers into the 21<sup>st</sup> Century and develop “robust” supply channels, which were not affected materially by external shocks and offered flexibility.
- TVA adopted as one channel an innovative proposal to meet incremental capacity needs by using derivative contracts to buy power as an alternative to building new generating plants.
- The proposal called for the creating of new financial contracts, Option Purchase Agreements, long-dated call(put) options on power purchased from (sold to) counterparts that could deliver the power into the grid.
- As a consequence of the implementation of OPA, TVA did **not** build two nuclear power plants [equivalent to 35 conventional ones]
- In 2016, TVA was responsible for 3.50% of all electric power generation in the United States.

Source: Peter Tufano, “Tennessee Valley Authority: Option Purchase Agreements”, HBS Case 9-296-038, February 1997

# Financial Innovation to Boost Future Productivity and Growth 2017 Into the Future

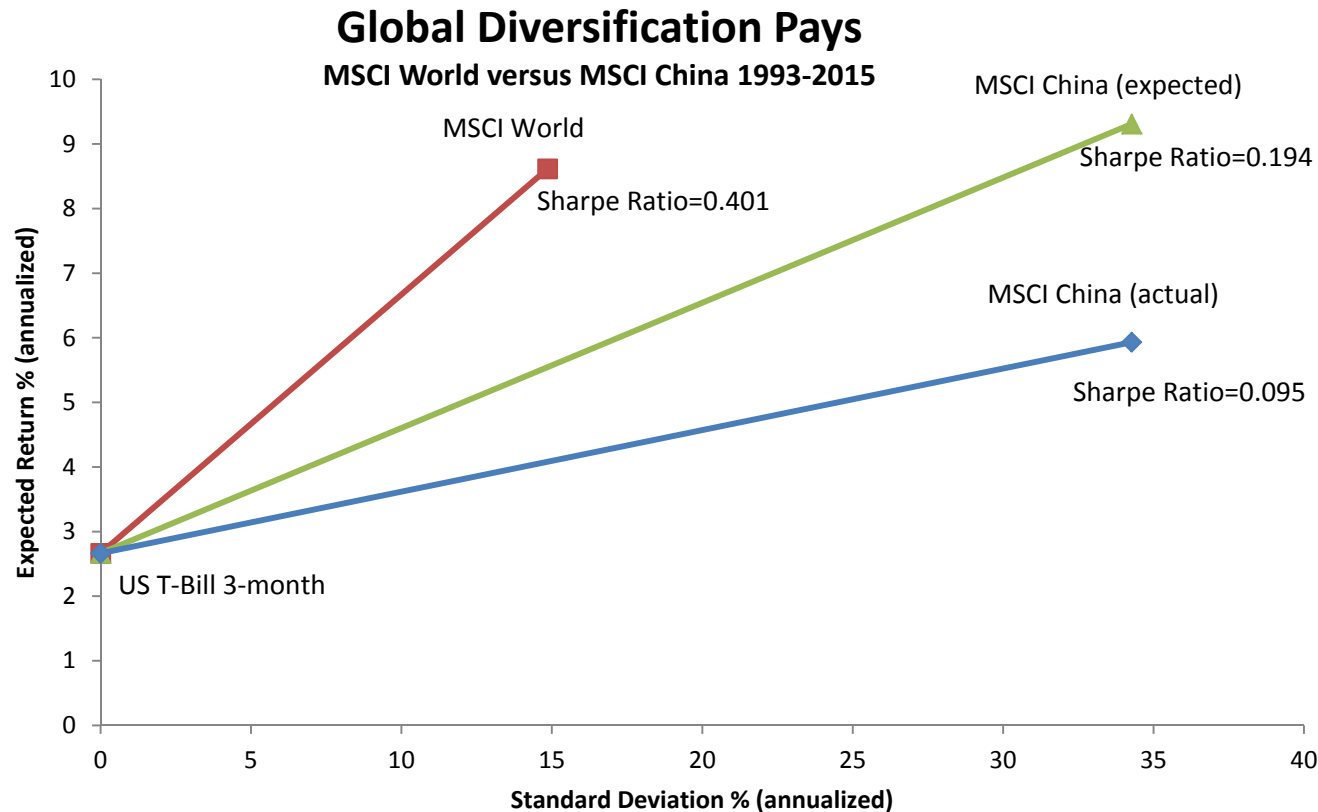
Improve the efficiency of risk-bearing to reduce the cost of capital for firms, increase rates of return to long-term investors, and reduce the cost of government stabilization policies

- Implementing more-efficient financial stabilization and growth policies
  - Capital controls, governance and local-investment issues surrounding government stabilization policies executed without bearing the costly “side-effects” from inefficient diversification : China in 2017
- Improving diversification as a “free” increase in return for the same risk
  - Increasing expected returns for the same risk for pension funds of retirement benefits and as a source of long-term capital for the economy: Thailand in 2017
- Improving wealth management and retail financial services
  - Combining financial innovation and technology to provide better quality and lower cost finance services: Fintech---
- Government’s role in improving financial system
  - “Market completion” issuing instruments that improve risk management such as per capita consumption-indexed bonds; regulation of financial markets and institutions; stabilization

# Capital-Controls Stabilization, Governance and Local Investment Policies Have “Side-Effect” Cost of Inefficient Diversification

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

## MSCI World versus MSCI China 1993-2015



Source: MSCI China total return index, MSCI World total return index, U.S. 3 month T-Bill rate, 1993-2015. Returns in USD. “Expected” = ex post 0-alpha, conditional on World realized return

# 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: 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

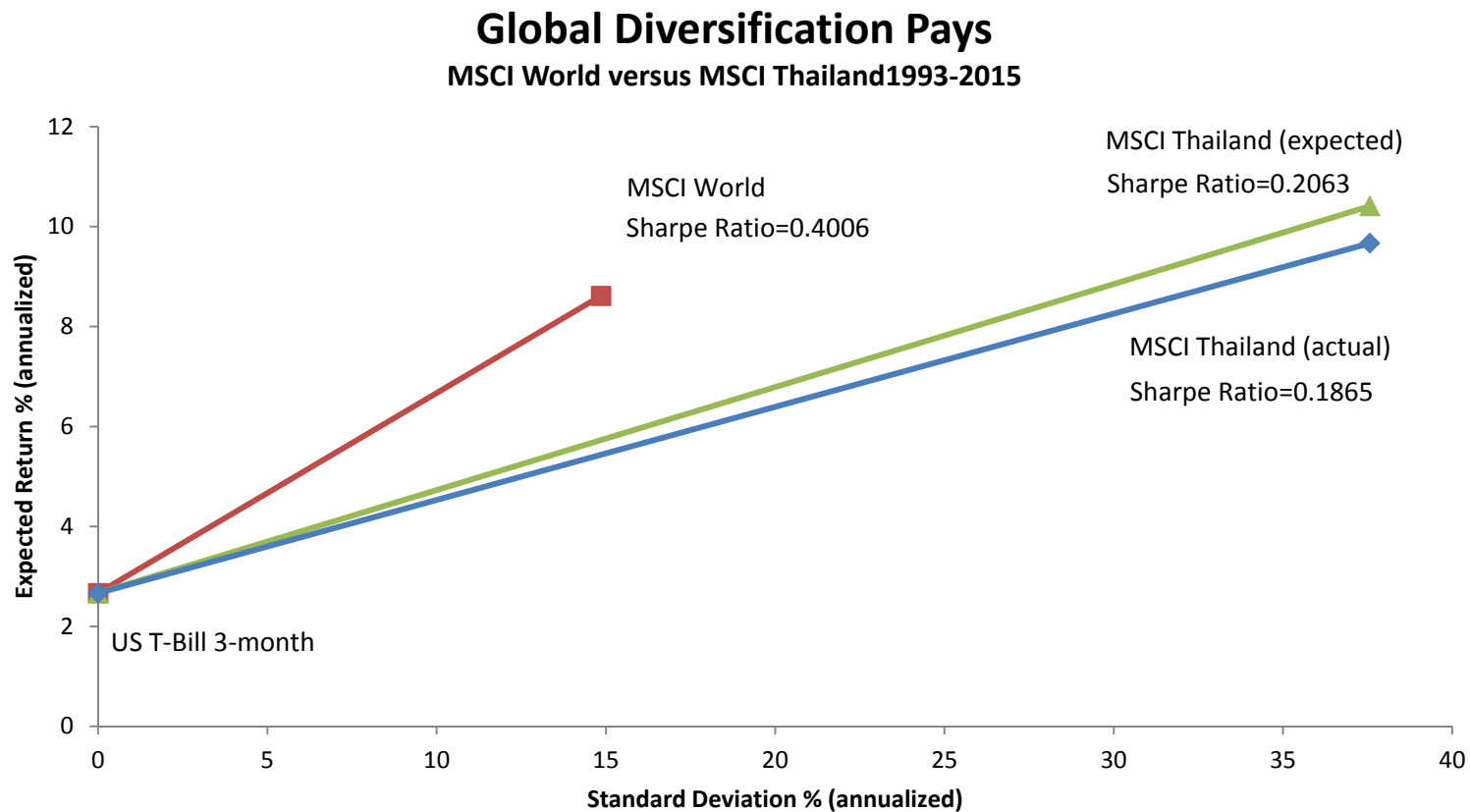
- *Lower Cost of Capital* through increased global risk-bearing of local risks
- *Always Natural Counterparties Available*: if a country has “too much” exposure to itself for efficient diversification, the rest of the world has “too little” exposure to that country.
- *Implementation*: Transact directly among sovereign wealth funds, government pension funds, reserves, and central banks, with no need to involve intermediary cost and credit risk
- *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

# Relative Advantage of Country Swaps for Diversifying Risk

- *Locals perform* industrial governance, trading in shares in local market, and local intermediation distribution of exposures to global asset returns
- Country retains full benefits/losses of local-country-specific component of industry returns; it keeps all of its “alpha” and avoids ex-post political risk accusation of “selling off the crown jewels of the country too cheaply”
- *Robust* with respect to local financial system design: works with financial stabilization policies (including capital controls), pay-as-you-go pension system, or no local stock market at all
- *Policy is non-invasive*: doesn’t require change in employment patterns and behavior, changes in industrial structure or changes in financial system design
- *Policy is reversible* by simply entering into an off-setting swap
- *Can be combined to efficiently address another major country issue*: pension system design and reform with efficient risk-bearing

# Global Diversification Pays – Thailand (alpha = - 0.74%)

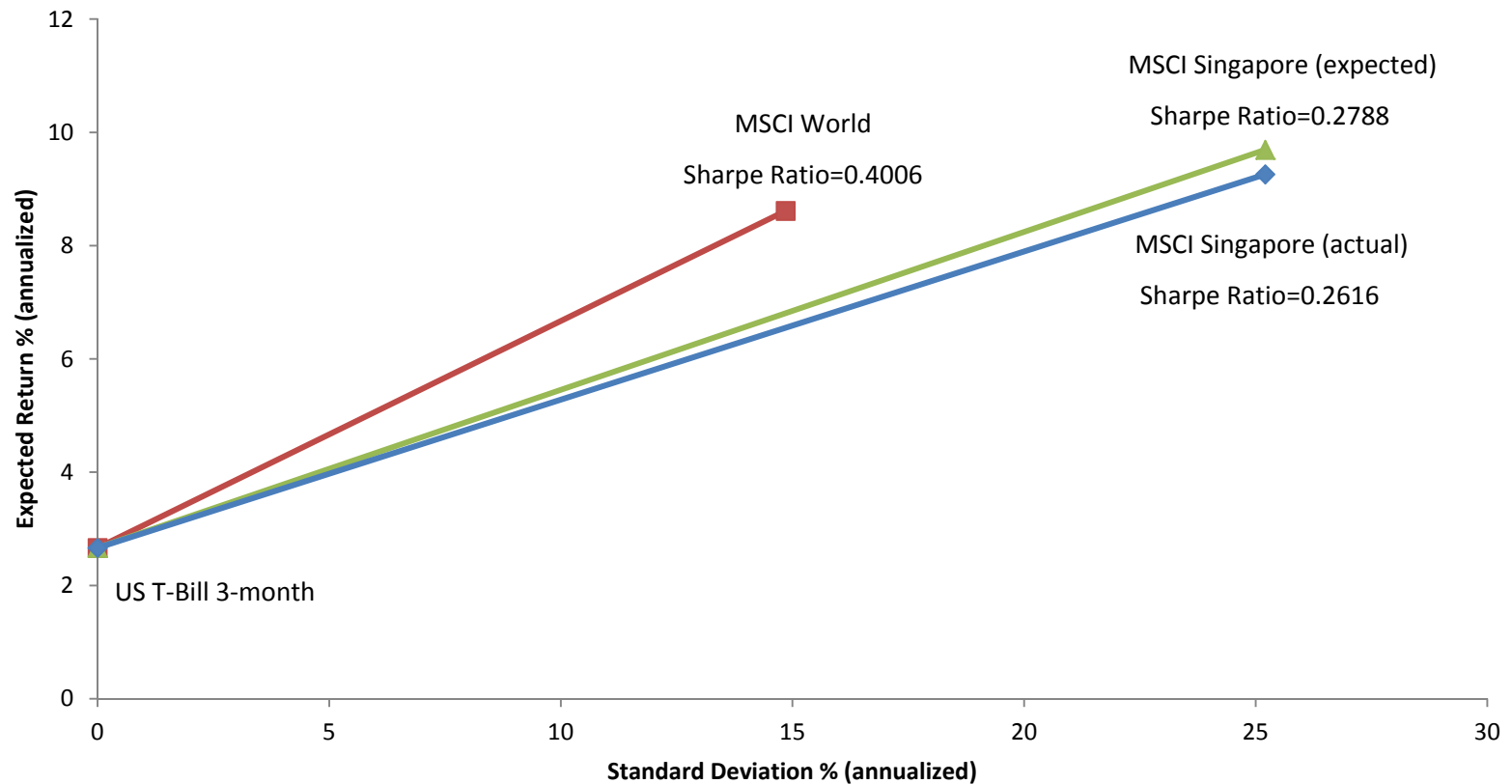
## MSCI World versus MSCI Thailand 1993-2015



Source: MSCI Thailand total return index, MSCI World total return index, U.S. 3 month T-Bill rate, 1993-2015. Returns in USD. "Expected" = ex post 0-alpha, conditional on World realized return

# Global Diversification Pays—Singapore (alpha = - 0.43%) MSCI World versus MSCI Singapore 1993-2015

**Global Diversification Pays**  
MSCI World versus MSCI Singapore 1993-2015

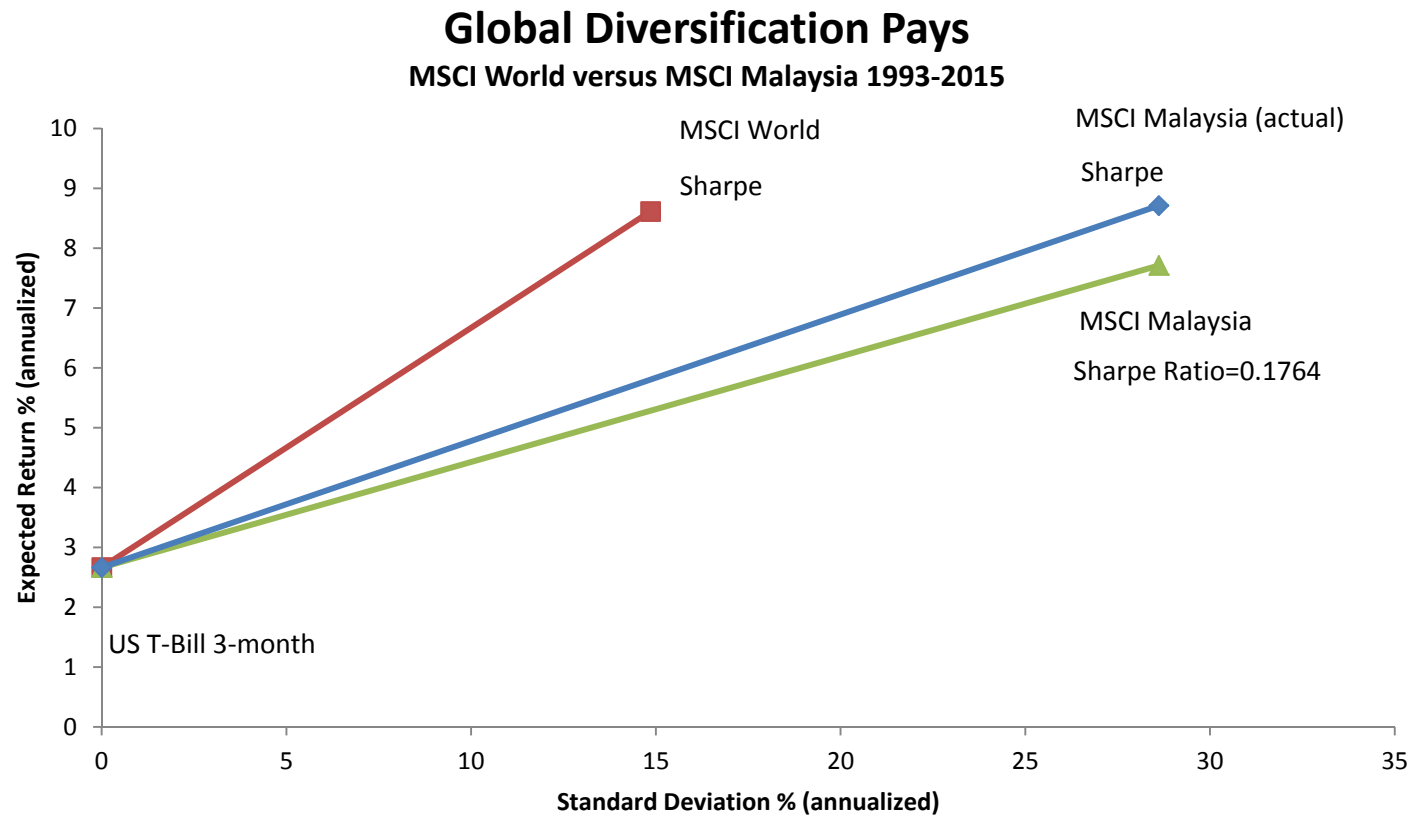


Source: MSCI Singapore total return index, MSCI World total return index, U.S. 3 month T-Bill rate, 1993-2015. Returns in USD. “Expected” = ex post 0-alpha, conditional on World realized return



# Global Diversification Pays for a Superior-Performing Country – Malaysia ( $\alpha = 1.00\%$ )

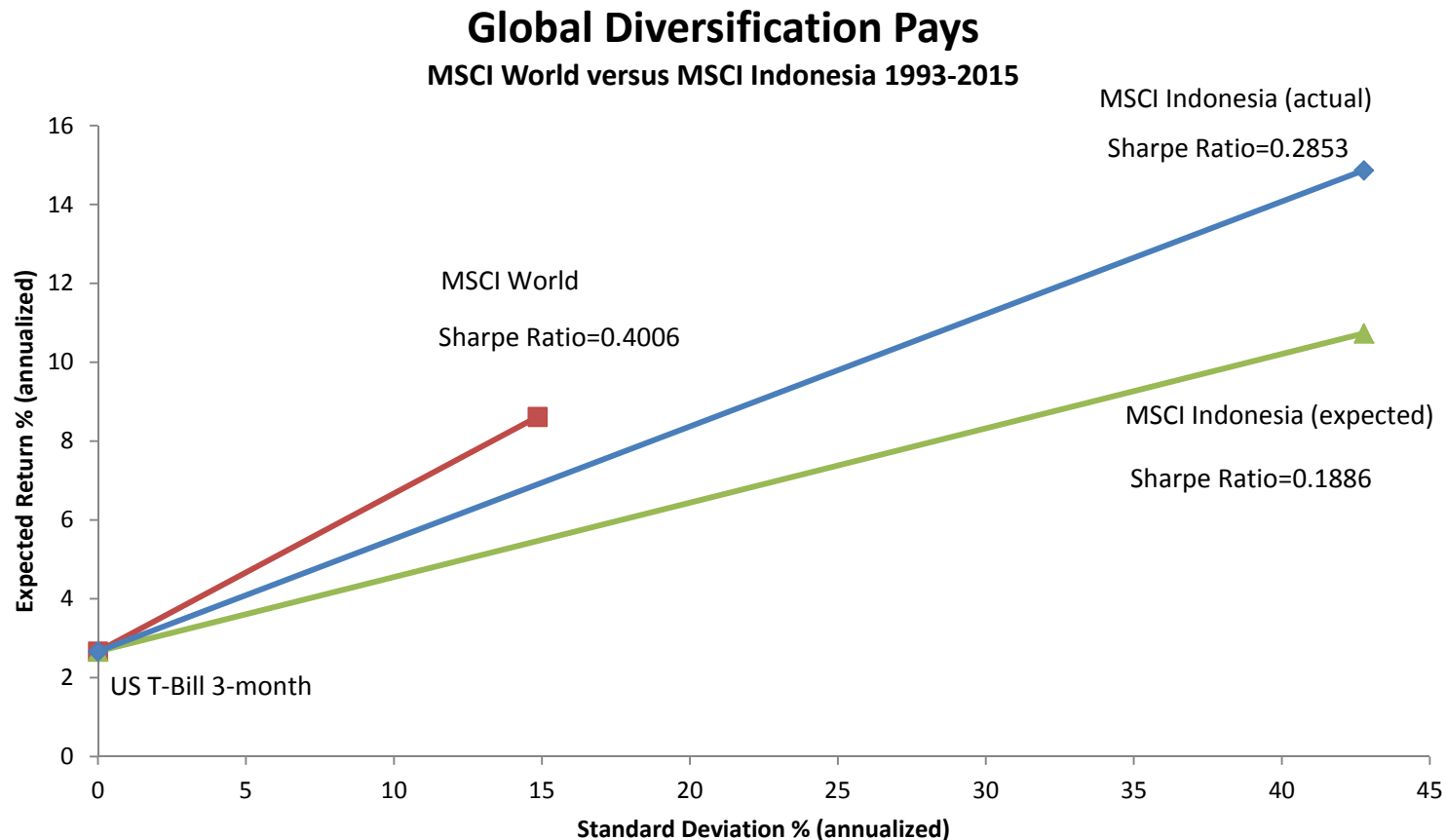
## MSCI World versus MSCI Malaysia 1993-2015



Source: MSCI Malaysia total return index, MSCI World total return index, U.S. 3 month T-Bill rate, 1993-2015. Returns in USD. “Expected” = ex post 0-alpha, conditional on World realized return

# Global Diversification Pays-Even for a Super-Superior Performing Country—Indonesia (alpha 4.13%)

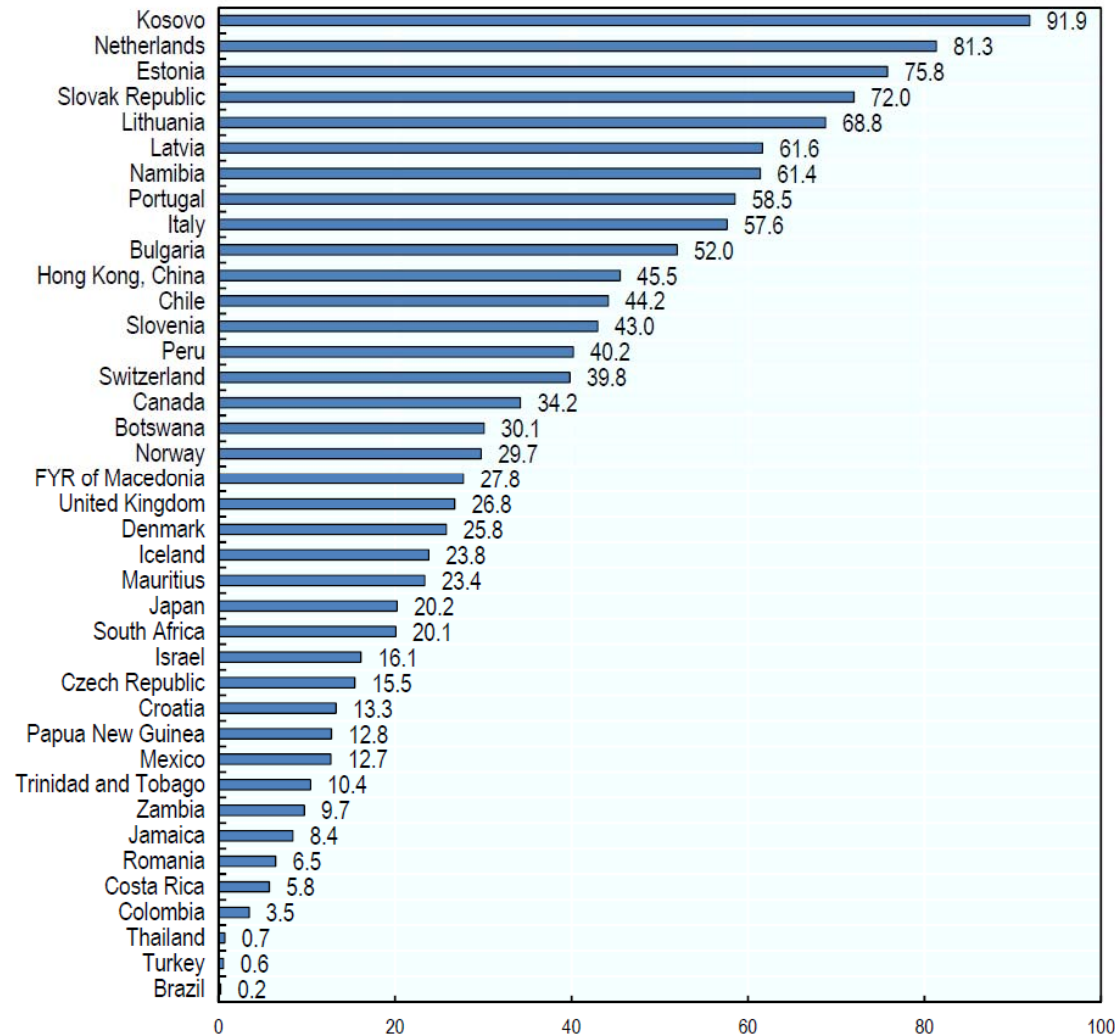
## MSCI World versus MSCI Indonesia 1993-2015



Source: MSCI Indonesia total return index, MSCI World total return index, U.S. 3 month T-Bill rate, 1993-2015. Returns in USD. "Expected" = ex post 0-alpha, conditional on World realized return

# Thailand Pension Funds Do Not Employ Global Diversification

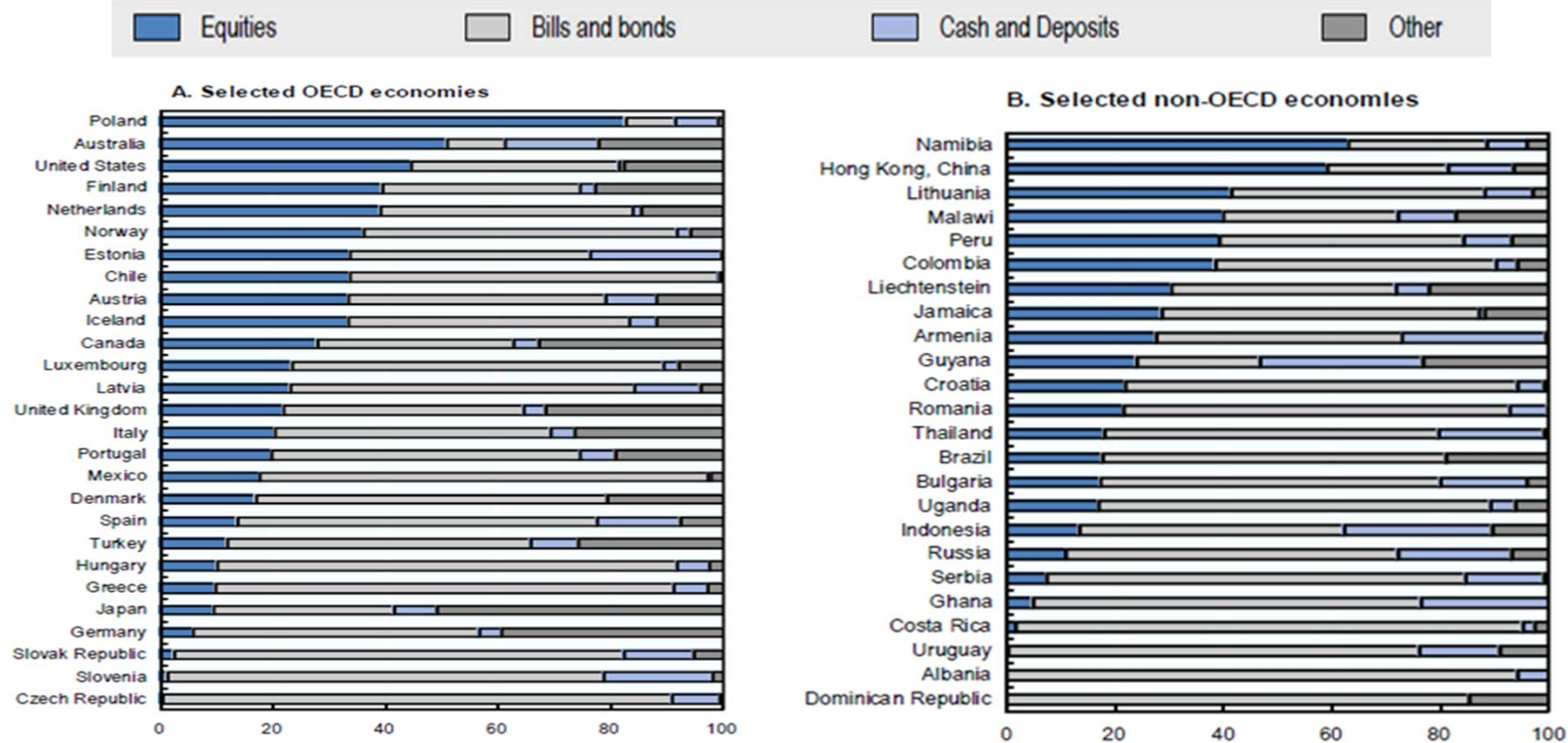
**Figure 18: Foreign investments of pension funds from selected OECD and non-OECD countries, 2015**  
*as a percentage of total investment*



Source: Pension Funds, Capital Markets, and the Power of Diversification, World Bank Group, WPS8136 July 2017

# Thailand Pension Funds Asset Class Allocation 62% Bonds, 20% Deposits and Cash, and 18% Equities

**Pension Fund Asset Allocation in Selected Asset Classes (2016)**  
*as a percentage of total investment*



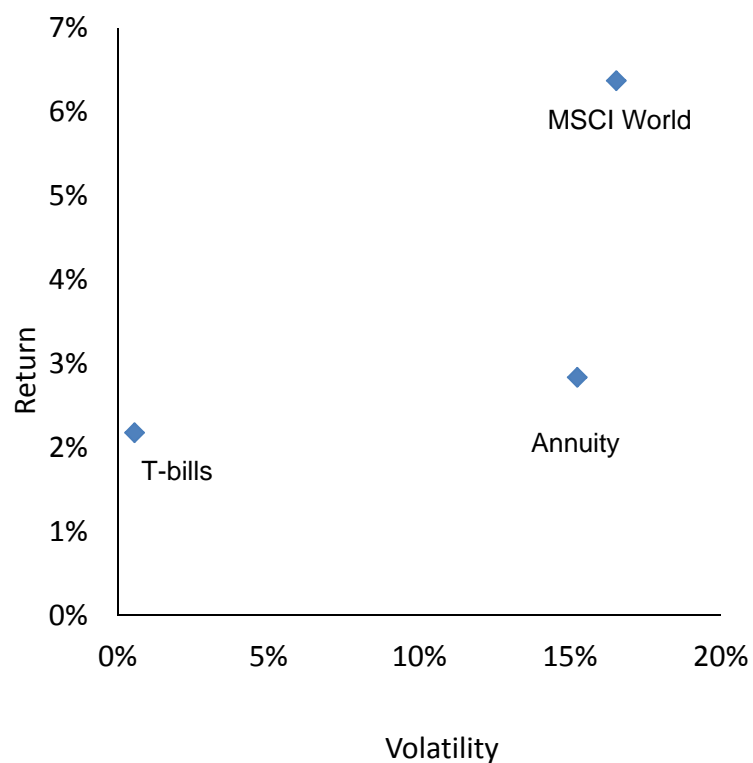
Source: Pension Funds, Capital Markets, and the Power of Diversification, World Bank Group, WPS8136 July 2017

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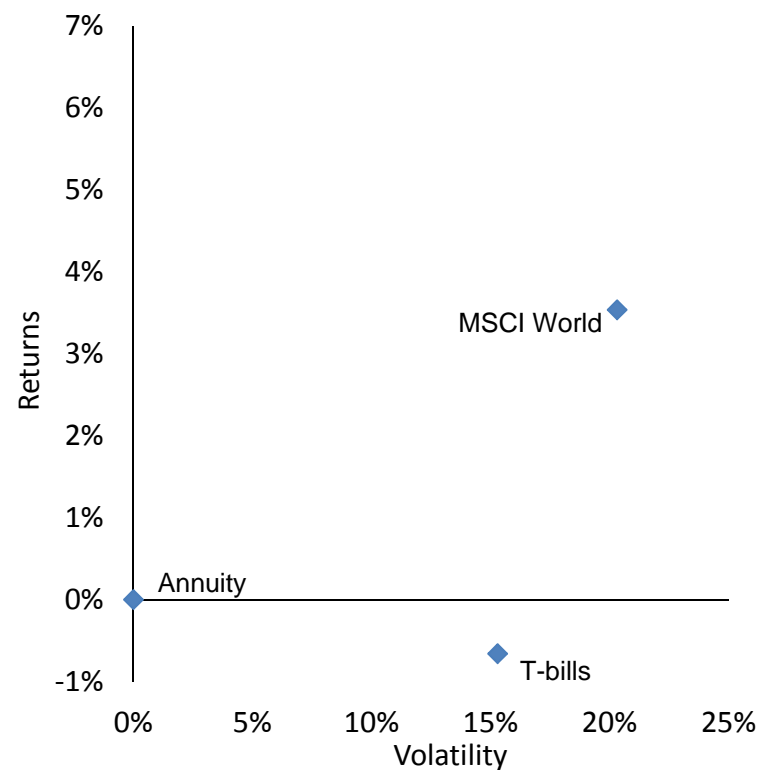
# Risk & Return--Wealth vs. Income Goal: Why Cash & Deposits Do Not Belong in the Strategic Allocation of a Pension Fund

Measure the risk/return trade-off correctly relative to the goal of retirement income and not wealth

US DOLLARS WEALTH GOAL



FUNDED-RATIO INCOME UNITS INCOME GOAL



# Derivative Markets Provide Pure Efficient Risk Transfer

- Derivatives are efficient “adapters” between heterogeneous financial systems, which improve global financial integration and diversification
- Derivatives provide efficient implementation of the three methods of managing risk: diversification, hedging and insurance
- Derivatives permit efficient risk diversification while implementing other objectives by separating risk-bearing choices from comparative advantage, cash investment, governance, liquidity, expropriation, and tax issues.
- Development of derivative markets for equities, interest rates, currencies and commodities promotes financial stability by multiple channels for risk transfer and information-extraction from prices
- Derivatives can improve the efficiency of open-market and stabilization operations: efficient trading and issue “open-market policy” securities
- Informed regulation to realize the benefits of financial innovation while managing its risks.

# Speaker Profile

Robert C. Merton is the School of Management Distinguished Professor of Finance at the MIT Sloan School of Management and University Professor Emeritus at Harvard University. He was the George Fisher Baker Professor of Business Administration (1988–98) and the John and Natty McArthur University Professor (1998–2010) at Harvard Business School. After receiving a Ph.D. in Economics from MIT in 1970, Merton served on the finance faculty of MIT's Sloan School of Management until 1988 at which time he was J.C. Penney Professor of Management. He is currently Resident Scientist at Dimensional Fund Advisors where he is the creator of Target Retirement Solution, a global integrated retirement-funding solution system.

Merton received the Alfred Nobel Memorial Prize in Economic Sciences in 1997 for a new method to determine the value of derivatives. He is past president of the American Finance Association, a member of the National Academy of Sciences, and a Fellow of the American Academy of Arts and Sciences.

Merton has also been recognized for translating finance science into practice. He received the inaugural Financial Engineer of the Year Award from the International Association for Quantitative Finance (formerly International Association of Financial Engineers), which also elected him a Senior Fellow. He received the 2011 CME Group Melamed-Arditti Innovation Award, and the 2013 WFE Award for Excellence from World Federation of Exchanges. A Distinguished Fellow of the Institute for Quantitative Research in Finance ('Q Group') and a Fellow of the Financial Management Association, Merton received the Nicholas Molodovsky Award from the CFA Institute. He is a member of the Halls of Fame of the Fixed Income Analyst Society, Risk, and Derivative Strategy magazines. Merton received Risk's Lifetime Achievement Award for contributions to the field of risk management and the 2014 Lifetime Achievement Award from the Financial Intermediation Research Society.

Merton's research focuses on finance theory, including lifecycle and retirement finance, optimal portfolio selection, capital asset pricing, pricing of derivative securities, credit risk, loan guarantees, financial innovation, the dynamics of institutional change, and improving the methods of measuring and managing macro-financial risk. Merton received a B.S. in Engineering Mathematics from Columbia University, a M.S. in Applied Mathematics from California Institute of Technology and a Ph.D. in Economics from Massachusetts Institute of Technology and holds honorary degrees from sixteen universities.