Solving Global Challenges Using Finance Science Past and Future

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Role of Financial Innovation and Finance Science in Economic Growth and Development

- Well-functioning financial system is essential for sustainable economic growth and development –financial innovation drives improvement of the financial system, and finance science, technology, and economic need drive financial innovation

  Robert M. Solow “Nobel Perspectives”, https://www.ubs.com/microsites/nobel-perspectives/en/robert-solow.html

- Crisis can slow or even reverse financial innovation as in 2008-9. But crisis can also induce implementation of financial innovation which leads to a permanently improved financial system, as in the 1970s-1980s

- When did Finance become a science? 1950s-1960s

- When and why did finance science and finance practice become inexorably connected? 1970s-1980s

Finance Becomes a Science 1950s-1960s

- **1952** Diversification– Markowitz Mean-Variance Portfolio Theory
- **1953** Role of securities in optimal risk allocation- Arrow
- **1958** Hedging – Tobin risk-free asset in portfolio theory
- **1958** Corporate finance capital structure and payout policy – Miller and Modigliani
- **1960-3** First comprehensive individual stock return data base, Chicago Center for Research in Security Prices
- **1963-5** Efficient Market Hypothesis – Fama; Samuelson
- **1965** Risk-based differences in expected returns - Sharpe-Lintner-Mossin Capital Asset Pricing Model (CAPM)
- **1965-70** Testing of various institutional investor performance using CAPM – Jensen, Roll

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

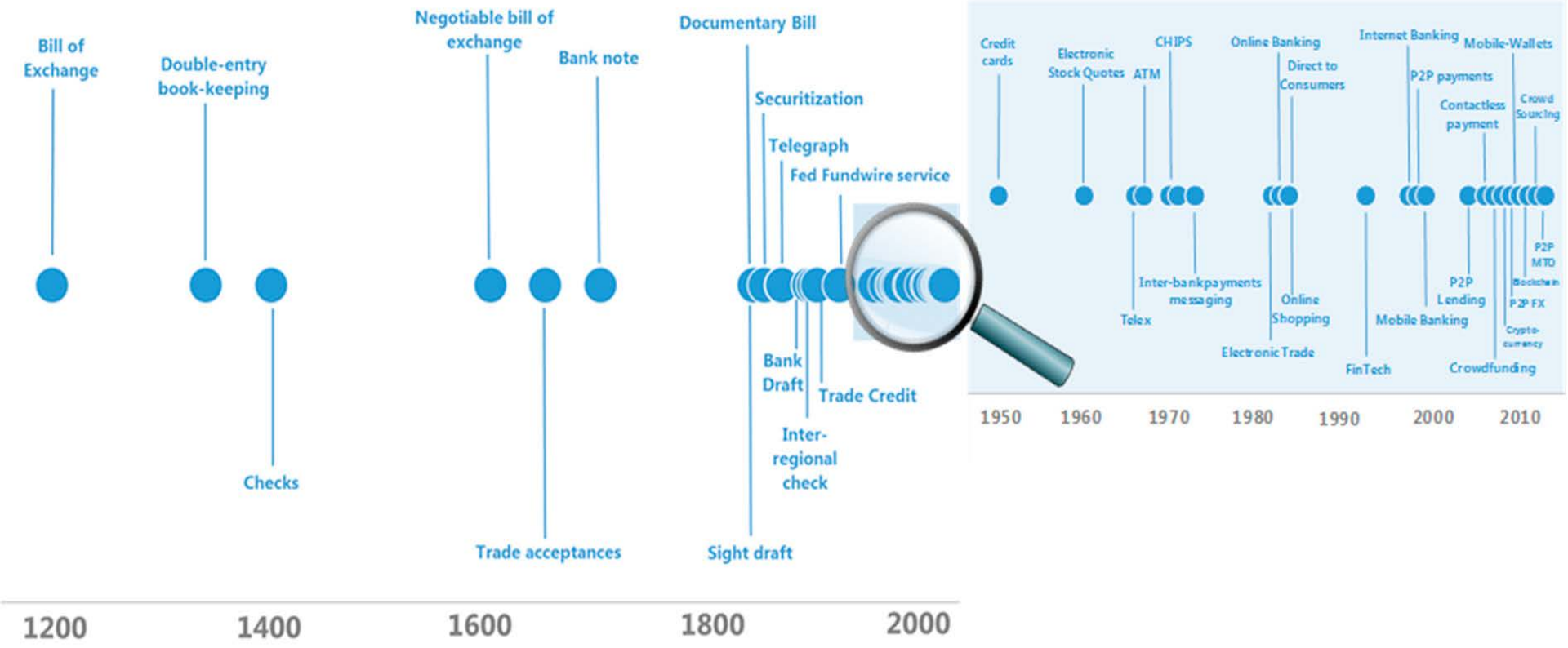
- Option exchange: financial value insurance
- Financial futures for currencies, interest rates, stocks
- NASDAQ , first electronic stock market
- Money market funds, high-yield and floating rate bonds
- Index funds Stage Coach Fund 1970 & Vanguard 1975
- TIAA-CREF institutional international diversification in stocks 1972
- ERISA 1974 employer-funded pension system creating pension funds
- May Day 1975 negotiated commissions- institutionalization of stock market
- Debt securitization and creation of a national mortgage market
- Interest rate fixed-to-floating swap eliminated the largest risk in banks
- Foundation set for globalization of capital markets: derivative markets adopted throughout the world and global diversification
- Finance science: existing and breakthrough quantitative models and data bases were essential for implementing these innovations

How Intangible Innovation from Finance Can Solve Tangible Challenges to Economic Growth and Stabilization

- Implementation of technology innovation in financial services, ”FinTech” (2018)
  - Global example: Financial and technological innovation, “FinTech”, offers enormous opportunities for lower cost and better performing financial services globally, with disproportional improvements accruing to those who are currently underserved by current standards. Its implementation however faces challenges. FinTech success will disrupt current financial-service providers. Who will be the “winners” and “losers”?

- Implementing more-efficient financial stabilization and growth policies (2018)
  - China example: Capital controls, governance and local investment government stabilization policies and lowering the cost of capital for growth, can each be executed, without bearing the costly “side-effects” from inefficient diversification, and actually improve stabilization.

Accelerating Pace of Technological Progress in Financial Services



Sources: Arner, Barberis, and Buckley (forthcoming); Quinn and Roberds (2008); World Economic Forum (2015).

Implementation of Technology Innovation in Financial Services FinTech

- Financial and technological innovation, “FinTech”, offers enormous opportunities for lower cost and better performing financial services globally, with disproportional improvements accruing to those who are currently underserved by current standards.

- FinTech innovations will create disruptive challenges for users, providers, advisors and regulators of financial services but will also create potentially significant opportunities for them

- Will today’s technology disruptions to current practice of existing financial-service providers lead to their displacement or will it create enhanced opportunities for them? Who will be the “Winners” and “losers” ?

- Trust is essential for user adoption of financial services. Technology by itself is not sufficient to create trust.

Where in Finance Will FinTech Succeed Quickly and Where Will It Face Challenges? What Does It Take to Overcome the Challenges?

- FinTech will succeed most easily in areas of financial services involving calculations, processing and record-keeping where performance can be readily tested and verified, and in any activity in which transparency can be adequately substituted for opaqueness. Either transparency or verification, when feasible, can substitute for trust.

- FinTech requires a model and the data to populate it. The model selected will depend on the objectives of the selector. Models require abstractions from complex reality and the selection of the abstractions involves judgment—the “art of the science” . The quality of the data used in the model is critical. These judgments are opaque, often difficult to verify, and thus, inherently require trust by users.

- FinTech with technology alone will be challenged in disrupting services and products that are “inherently opaque [i.e., cannot be made transparent] such as financial advice, solutions and many integrated financial products. The only means of providing those services and products is through trust.

Verification: How Long Does It Take to Verify Superior Advice? How Much Outperformance or Underperformance is Required to Verify within a Fixed Time Horizon?

- Historical average return = 15% and standard deviation = 20%
- 95% confidence level of outperformance or underperformance [t-statistic = 2.0]
- What future realized sample returns would be needed to achieve significance?

PERIOD OF PAST HISTORY = 10 YEARS

Future Observation Period	Required Outcome
5 years	< - 12% or > 42%
10 years	< - 7% or > 37%
20 years	< - 5% or > 35%

PERIOD OF PAST HISTORY = 30 YEARS

Future Observation Period	Required Outcome
5 years	< - 9% or > 39%
10 years	< - 3% or > 33%
20 years	< 0% or > 30%

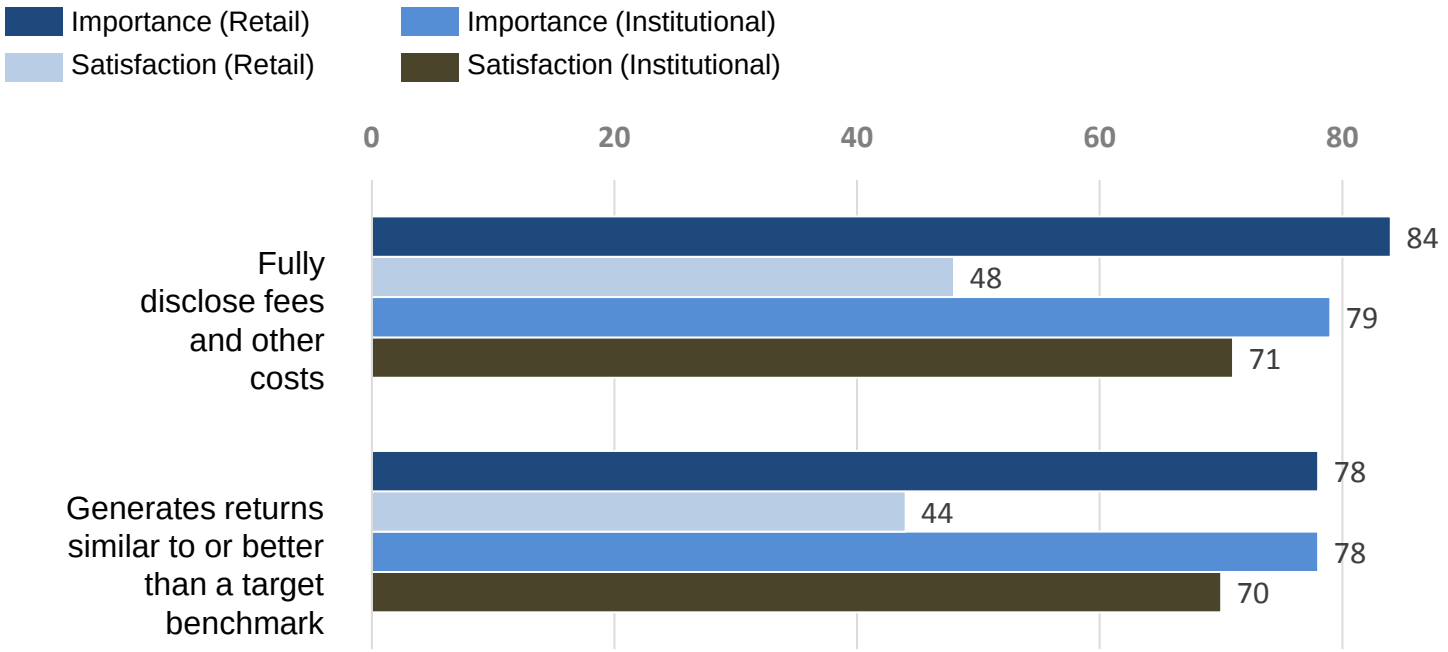
Practical conclusion: performance cannot be verified based on return series alone

Trust is Essential for FinTech to Succeed and Fintech's Success Will Enhance the Value of Trust

- Trust requires two components: 1. trustworthy 2. competence.
- FinTech increases time efficiency and lowers cost by substituting "black box" technology for human efforts of both advisors and providers but in doing so it also increases "opacity", which in turn makes trust an even more important and valuable asset. FinTech's success will thus drive increasing value for the trusted advisor, provider, consultant and overseer.
- Technological advances will likely leverage providers who have the "trust asset" to enhance their expansion instead of taking business away from them. Technology to succeed will have to partner with entities that can provide the trust asset, since it cannot create trust by itself. The trusted provider must assess the risk of lost of its valuable asset by supporting a Fintech that fails. How will the value jointly created be shared between the technology and the trust assets?
- Consumers of financial services lost trust in their providers and their regulators in the 2008-9 crisis. Financial advisors and institutions with business strategies based on restoring trust by minimizing conflicts of interest, such as fee-only independent advisors, will disrupt traditional product-based wealth-management models with captive distribution broker and adviser systems. Will established institutions that are trusted and adopt Fintech have an advantage over new FinTech entrants into financial services? Will the industry become more fragmented or concentrated?

Missing Trust—Lost in Financial Crisis 2008-9
Retail Investors Register Low Satisfaction with Cost Disclosures and Performance from Active Portfolio Managers

Satisfaction and Importance ratings by investors (%)



Source: CFA Institute
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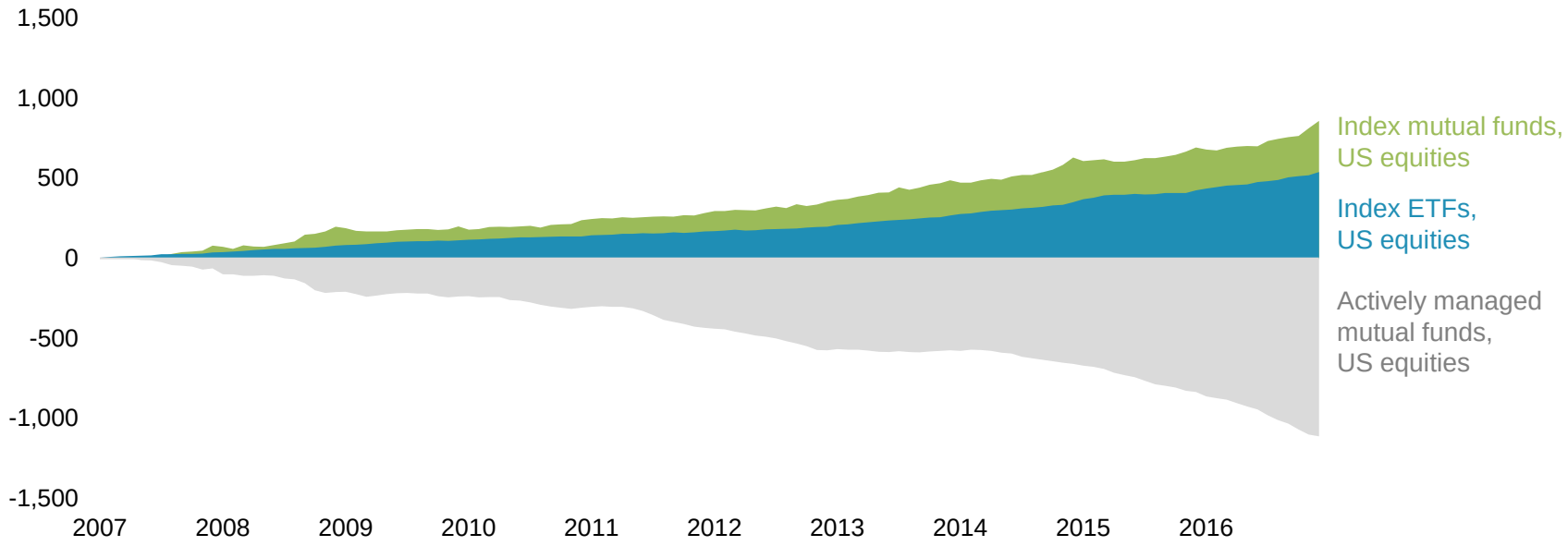
Growth of Index Funds and ETFs vs. Actively Managed Funds Industry Impact of a Loss of Investor Trust 2008-9 and a Continuing Flight to Transparency as a Second-Best Strategy?



Source: 2017 ICI Factbook. http://www.icifactbook.org/ch2/17_fb_ch2

Cumulative flows to and net share issuance of index mutual funds (US equities) and index ETFs (US equities), billions of dollars; monthly, January 2007–December 2016. Prior to October 2009, index equity Index ETF (US equities) data include a small number of actively managed domestic equity ETFs. Note: Equity mutual fund data include net new cash flow and reinvested dividends. Data exclude funds that invest primarily in other funds.

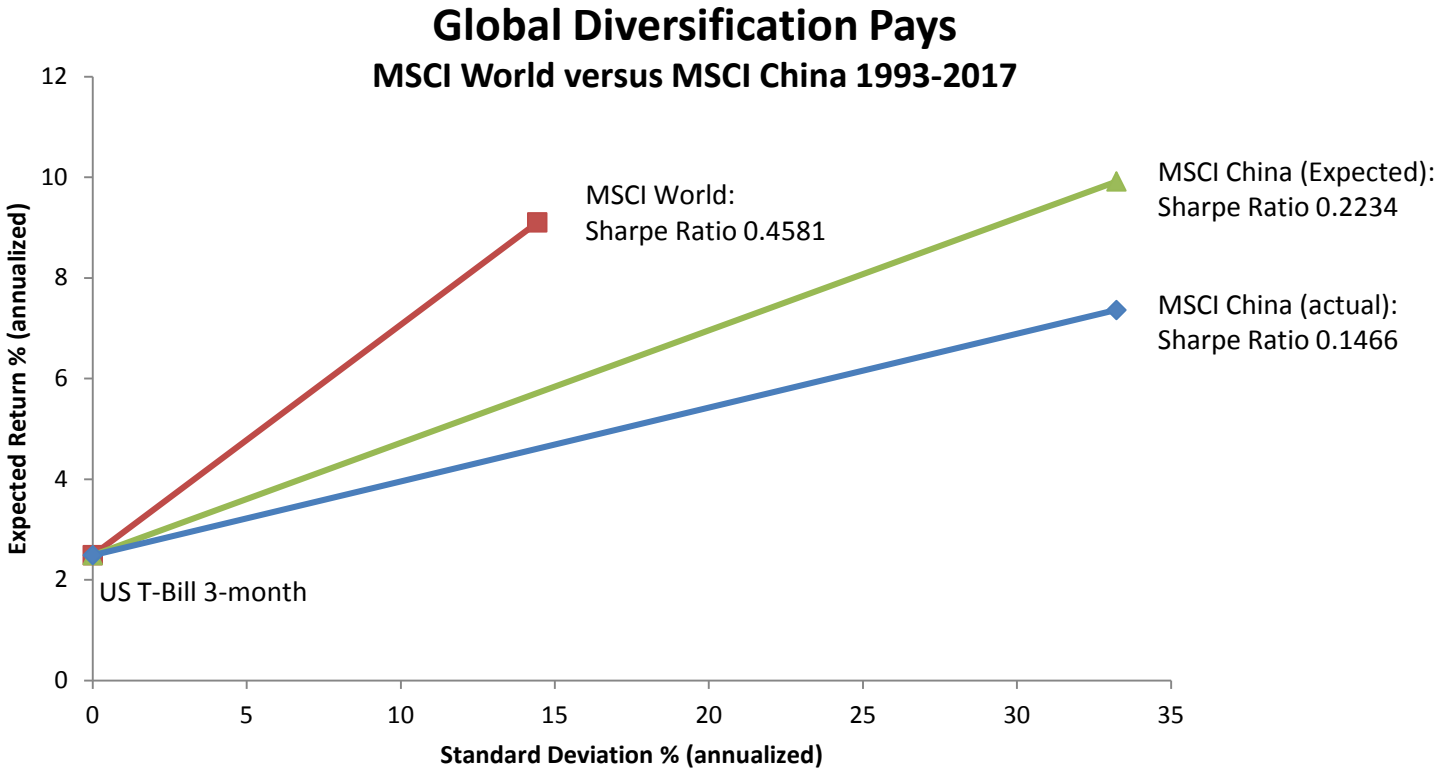
Block-Chain Technology with Great Potential Impact on Industry The Essential Role of Trust in Its Successful Implementation

- Determining ownership –clearing and settling transactions—is a fundamental function in both finance and real estate—Block Chain offers transformational potential for a non-centralized, efficient, low-cost and highly reliable method for clearing & settling.
- Block Chain cannot succeed unless it is accepted and therefore trusted.
- How do the users determine the motivation of the creator of the system?
- How do the users determine the quality of the specific block-chain model used in the system?
- How do the users determine the quality and completeness of the data used in the model?
- How do the users determine the degree of security for the data, the model and their personal information within the system?
- How do the users determine the reliability of who is responsible if the system fails?

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 1993-2017



- Source: MSCI China total return index, MSCI World total return index, U.S. 3 month T-Bill rate, 1993-2015. Returns in USD. "Expected" = expost 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

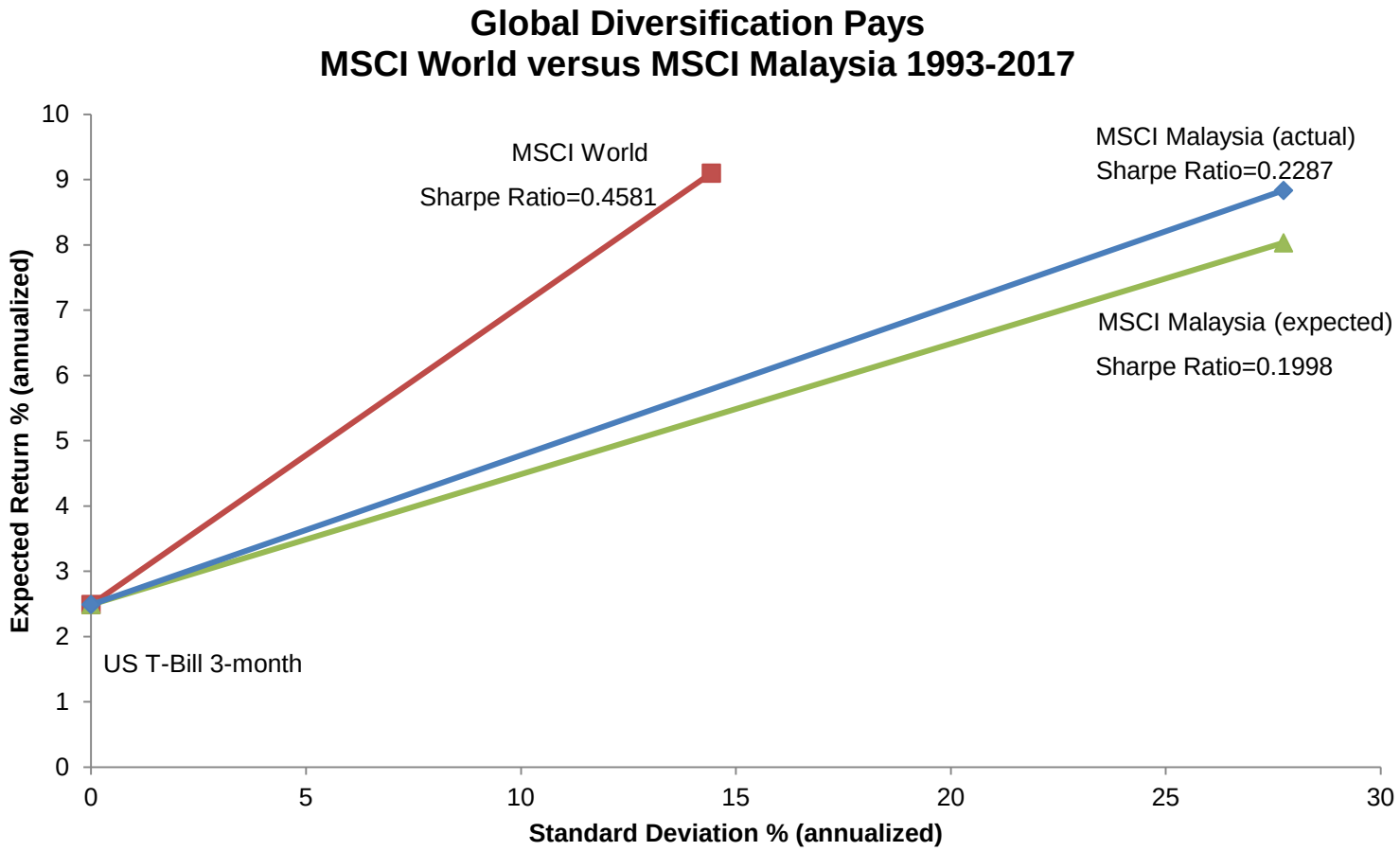
China SWF/Pension Fund Return = Return World stocks
Well-Diversified Equity Risk

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.

There Can be Substantial Cost from Inefficient Diversification Even for a Superior-Performing Country

Cost of Investing and Risk-Bearing to Domestic Holders from only domestic investment Can be Substantial – Malaysia as a Case Study

MSCI World versus MSCI Malaysia 1993-2017



Source: MSCI Malaysia total return index, MSCI World total return index, U.S. 3 month T-Bill rate, 1993-2017. Returns in USD. "Expected" = expost 0-alpha, conditional on World realized return

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Speaker Profile

Robert C. Merton is the School of Management Distinguished Professor of Finance at the MIT Sloan School of Management and John and Natty McArthur 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. He received the 2017 Finance Diamond Prize from Fundación de Investigación, IMEF.

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 eighteen universities.
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