

Dr. R H Patil Memorial Lecture - 2018

BY

Prof. Robert C Merton

- Alfred Nobel Memorial Prize in Economic Sciences, 1997
- School of Management Distinguished Professor of Finance,
MIT Sloan School of Management
- Resident Scientist, Dimensional Holdings, Inc.



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Mumbai



NSE

National Stock Exchange of India Limited

About NSE

NSE is India's leading multi-asset exchange which enjoys significant market share leadership in Equity, Equity Derivatives and Currency Derivatives. Recently NSE has renewed its focus on developing India's nascent Debt Market and grow the Commodities Derivatives market.

Globally, NSE is ranked as number 1 in Index options contracts traded and number 2 in Equity trades, Stock Futures contracts Currency Futures and options contracts as per WFE data Aug 2018. NSE is also the preferred exchange for global investors to invest in Indian markets and enjoys an overwhelming share of global inflows into Indian markets.

NSE has a fully-integrated business model comprising of exchange listings, trading services, clearing and settlement services, indices, market data feeds, technology solutions and financial education offerings.

NSE intends to play a key role in the development of India's markets and in providing the products and infrastructure to fund India's growth through better intermediation of savings and providing access to capital to our country's companies and entrepreneurs.

Guided by its purpose of improving the financial well-being of India's people, NSE is committed to support and help India in its aspirations to become one of the world's leading economies.



FOREWORD

When an institution of national importance completes 25 years of its existence, it is only fitting that the celebration is marked with an event of equal stature.

NSE's Silver Jubilee anniversary was marked with a lecture in honour of its Founding Managing Director, Dr. R H Patil. The lecture, the first of the series, will be an annual event that will feature thought leaders of the highest calibre and reputation as a fitting tribute to the memory of Dr. R H Patil.

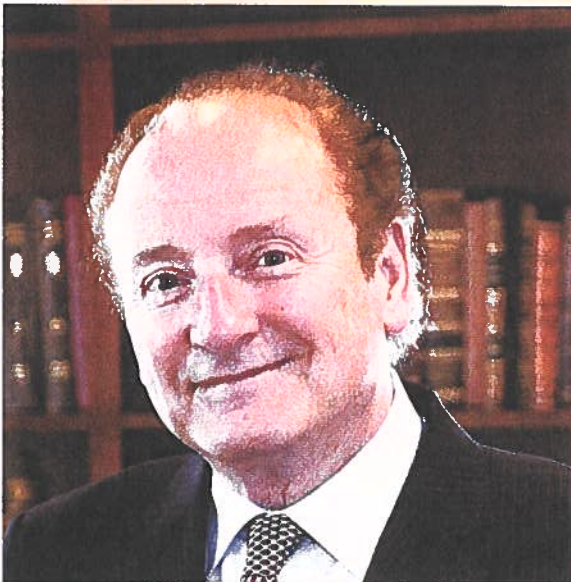
Noble Laureate Prof. Robert C Merton, was the keynote speaker for the Dr. R H Patil Memorial Lecture, 2018.



Dr. R H Patil

Founding Managing Director of NSE

An economist by qualification, Dr. R H Patil started his career with RBI and then moved to IDBI. Tasked with setting up India's first modern, de-mutualised, institution-led exchange, Dr. R H Patil played a pivotal role in the transformation of Indian capital markets. Dr. R H Patil led the team that set up NSE and also set up India's first clearing corporation, NSE Clearing Limited (formerly known as National Securities Clearing Corporation Limited, NSCCL) and the first depository, National Securities Depository Limited, (NSDL). He was an inspiring leader, a visionary, a pioneer, an institution builder par excellence and a wonderful human being.

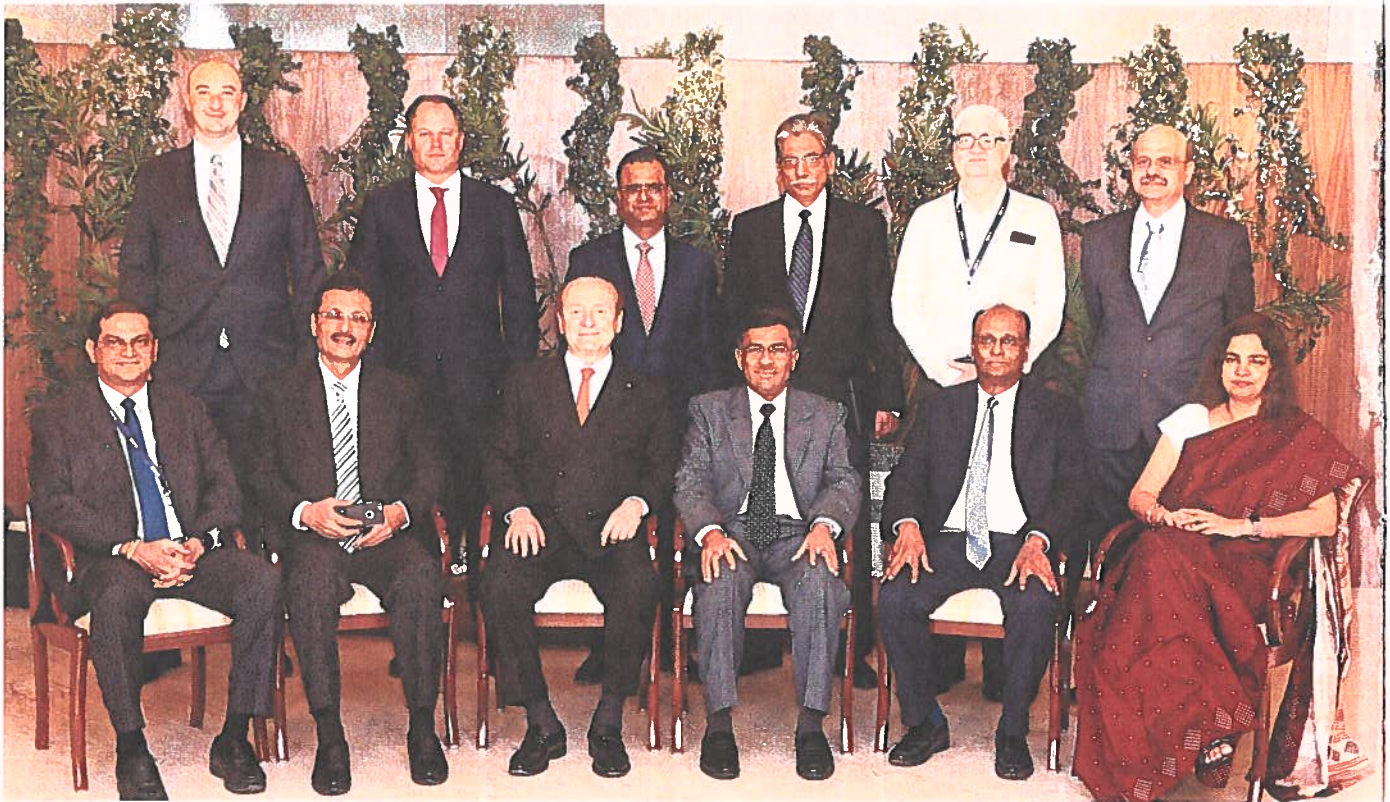
**Prof. Robert C Merton**

Noble Prize Winner in Economic Science, 1997

Keynote Speaker, Prof. Robert C Merton, is known for his pioneering contributions to continuous-time finance and the Black-Scholes-Merton Model for derivative valuations. He received the Nobel Prize in Economics in 1997. Prof. Robert C Merton is the School of Management Distinguished Professor of Finance, MIT Sloan School of Management and also Resident Scientist, Dimensional Holdings, Inc. He is former 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.

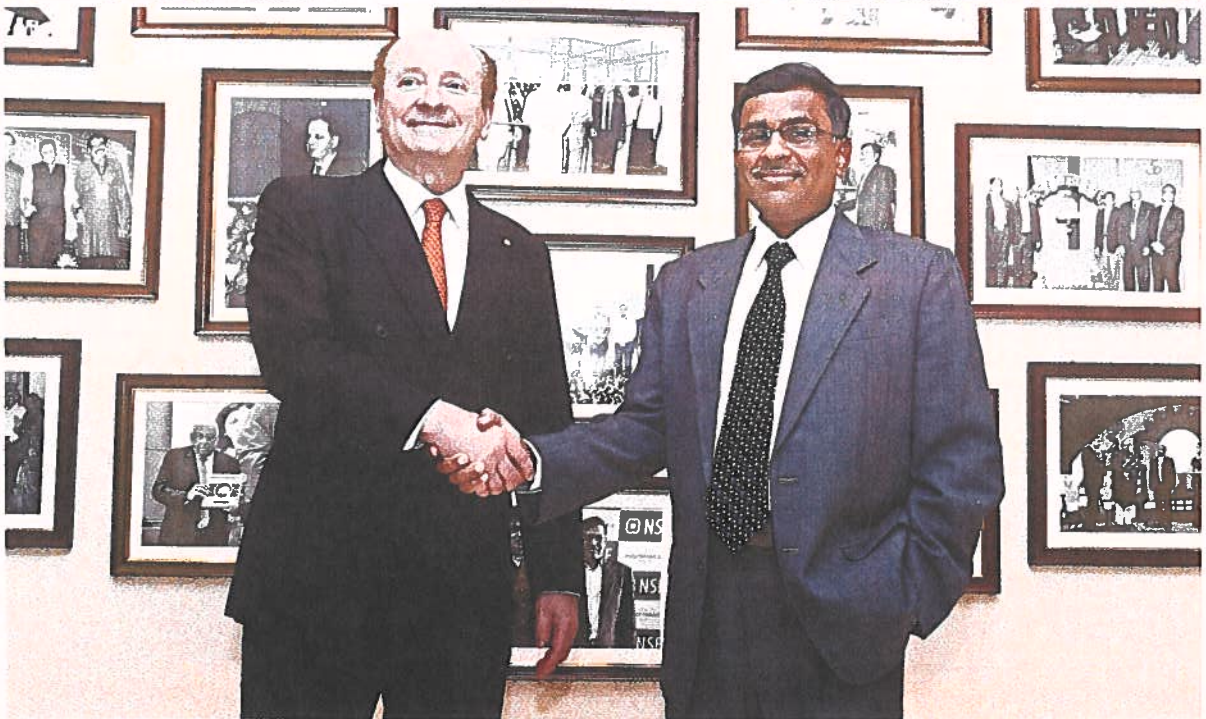
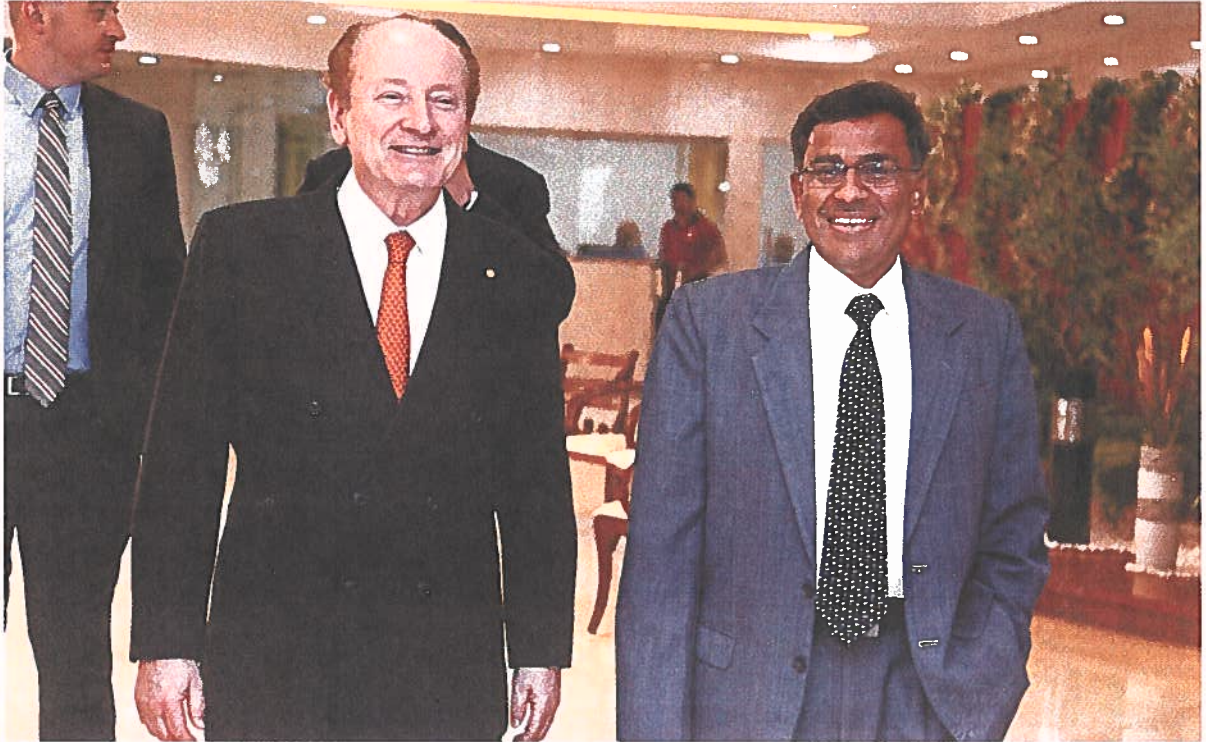
Prof. Robert C Merton has been recognized for translating finance science into practice. His research focusses on finance theory, including life-cycle finance, optimal inter-temporal portfolio selection, capital asset pricing, pricing of options, risky corporate debt, loan guarantees, and other complex derivative securities. Derivatives Strategy magazine elevated him to its Derivatives Hall of Fame as did Risk magazine to its Risk Hall of Fame. He also received Risk's Lifetime Achievement Award for contributions to the field of risk management.

Prof. Robert C Merton's visit to NSE



(Sitting from left) Mr. Ravi Varanasi (Chief Business Development Officer), Mr. Yatrik Vin (CFO, Group Accounts and Finance), Prof. Robert C Merton, Mr. Vikram Limaye (MD & CEO, NSE), Mr. J Ravichandran (Group President) and Ms. Priya Subbaraman (Chief Regulatory Officer). (Standing from left) Mr. Greg Folan (Dimensional Holdings, Inc), Mr. Carlo Venes (Dimensional Holdings, Inc), Mr. Mukesh Agarwal (CEO, NSE Indices and Data Analytics), Mr. N Muralidaran (CEO, NSEIT), Mr. G M Shenoy (Chief Technology Officer) and Mr. K Medh (Head - Marketing).

Prof. Robert C Merton and Mr. Vikram Limaye (MD & CEO, NSE) sharing a light moment.



Prof. Robert C Merton and Mr. Vikram Limaye (MD & CEO, NSE) at Wall of Memory, NSE.

Interaction with NSE's Senior management team. (Facing the camera from left to right) Mr. G M Shenoy (Chief Technology Officer), Mr. N Muralidaran (CEO, NSEIT), Mr. Carlo Venes (Dimensional Holdings, Inc), Mr. Greg Folan (Dimensional Holdings, Inc), Prof. Robert C Merton, Mr. Vikram Limaye (MD & CEO, NSE), Mr. Ravi Varanasi (Chief Business Development Officer), Mr. Yatrik Vin (CFO, Group Accounts and Finance), and Mr. Mukesh Agarwal (CEO, NSE Indices and Data Analytics)(partly hidden)



Interaction with NSE's Senior management team. (Facing the camera from left to right) Mr. Ravi Varanasi (Chief Business Development Officer), Mr. Yatrik Vin (CFO, Group Accounts and Finance), Mr. Mukesh Agarwal (CEO, NSE Indices and Data Analytics), Mr. J Ravichandran (Group President) and Ms Priya Subbaraman (Chief Regulatory Officer). (Back to the camera, left to right) Mr. Vikram Limaye (MD & CEO, NSE), Prof. Robert C Merton, Mr. Greg Folan (Dimensional Holdings, Inc), Mr. Carlo Venes (Dimensional Holdings, Inc) and Mr. G M Shenoy (Chief Technology Officer)

Dr. R H Patil Memorial Lecture 2018

Welcome speech by Mr Vikram Limaye (MD & CEO, NSE)



Ladies and Gentlemen,

A very warm welcome to all of you. This year we are celebrating NSE's Silver Jubilee anniversary and have decided to hold an annual lecture in the memory of our Founding Managing Director, Dr. R H Patil. This will be an annual lecture that will feature thought leaders of the highest calibre and reputation as a fitting tribute to the memory of Dr. Patil who is one of the tallest leaders and institutional builders of the Indian Financial Services landscape.

It was the passing of the SEBI Act in 1992 post the Harshad Mehta scam which paved the way for setting up of a modern exchange and IDBI was charged with the responsibility of leading a group of institutions that would eventually set up the National Stock Exchange. The then Chairman of IDBI, Shri S S Nadkarni assigned the project to Dr. R H Patil. NSE was incorporated in 1993 and commenced trading in 1994. It was the first demutualized exchange with an institutional shareholding base and professionally managed.

The new exchange managed to achieve the remarkable feat of overcoming tradition, practices and strong loyalties that were over a century old and lot of scepticism from market participants, and resistance from entrenched businesses. **Dr. Patil had the foresight and vision to set up a technology led, nationwide disruptive platform that challenged the status quo and brought in best in class standards and practices.** NSE revolutionised markets through a pan India network of connectivity and technology that was no mean achievement during the mid-90s. Nationwide 24X7 connectivity was a daunting task during those times and it was achieved through a V-SAT network – NSE had to become a telecom company as it became an exchange.

NSE under the leadership of Dr. Patil had many firsts including setting up the first Clearing Corporation and depository. Dr. Patil was also responsible for setting up the Clearing Corporation of India. These were critical market infrastructure institutions to guarantee settlement, provide dematerialization of securities to eradicate problems of bad delivery and fraudulent and duplicate certificates to establish trust in markets. NSE owes a deep sense of gratitude to the vision and missionary zeal of Dr. Patil, the founding team, past and present employees, SEBI and the government for putting in place critical market infrastructure institutions that have been responsible for the tremendous growth of our economy and capital markets over the past two decades. **Dr. Patil was an institution builder and has contributed significantly to the development of the Indian capital markets.** He was a wonderful and humble human being with a strong value system and an ability to motivate and nurture talent. NSE was indeed fortunate to have Dr. Patil as its founding Managing Director and owes a deep sense of gratitude to his many contributions.

NSE over a relatively short period of time has emerged as one of the largest exchanges in the world. It is the second largest exchange in the world in terms of number of contracts traded in the derivatives segment. In India, NSE has almost 100% market share of the

equity derivatives market, 90% of the cash equities market, almost 60% of the currency derivatives market and approximately 75% of the fixed income markets. **Few institutions in India have built a strong global reputation and I would submit NSE is one of them.** As an institution of national importance, NSE plays a critical role in working with regulators, government and market participants in the development of markets. NSE has always focused on what is in the best interests of the Indian economy, markets and investors and is focused on improving the financial wellbeing of people. **We recognise our responsibility to help India achieve its aspirations and take its rightful place amongst the world's leading economies.**

In order to achieve sustainable high rates of GDP growth, it is critical that we expedite market development and capital formation. While the equity markets in India are relatively well developed, penetration is still low relative to emerging market averages. We need to continue to focus on finding creative ways for investor education and awareness. NSE has an elaborate investor education and awareness program across 500 districts that includes over 2500 programs conducted through the year and partnerships to deliver digital programs in order to achieve scale. Beyond the equity markets, bond markets, currency and commodity markets are at a nascent stage relative to potential and it is critical that these markets develop over the next 2-3 years.

NSE has recently entered the commodities segment and we are optimistic about the development of this market. I am encouraged by recent steps taken to develop the bond market and my hope is that both primary and secondary market activity in corporate bonds will develop over the next 18 months. Access to capital for SMEs is another important aspect to support growth and employment. NSE is doing its bit to provide an ecosystem for equity and debt financing for SMEs through the NSE Emerge platform for SME IPOs and the bill discounting exchange, RXIL for providing working capital financing for SMEs. We have over 175 companies listed on the SME IPO platform and the receivables

discounting platform that we have as a JV with SIDBI has enormous potential.

It is important that the trust in markets is enhanced and that we further integrate the Indian economy and markets into the global ecosystem. We need to therefore make sure that markets develop in a disciplined way and NSE is focused on ensuring the highest standards of governance amongst listed corporates and integrity of markets through regulation and surveillance of market intermediaries and trading activity. Technology and risk management are critical areas of focus and we will continue to invest in these areas. From a policy and regulatory standpoint, it is important to demonstrate stability of policy, regulations and taxation in order to give confidence to investors. We need to also focus on making sure that we continue to streamline compliance requirements to make it easier for people to invest in Indian markets. Product innovation and simplicity are also critical to further penetrate and intermediate retail savings into markets and the growth of the ETF market could be an important driver to improve penetration.

We have come a long way over the last 25 years in the evolution of markets and the growth of our economy and we all need to recommit ourselves to creating the right environment and institutional architecture that is important to drive growth and development over the next 25 years. NSE is committed to contributing to the development of the economy, markets and the financial wellbeing of people. As we reflect on the evolution over the last 25 years and the bold vision of Dr. Patil in creating institutions that have stood the test of time and have been critical for our development, we need to re-imagine the future and embrace technology and encourage innovation to drive productivity and growth.

We are very fortunate and honoured to have with us Prof Robert Merton as our key note speaker for our first Dr. Patil memorial lecture. Please put your hands together in welcoming Prof Merton to India and NSE.

Prof Merton is the School of Management Distinguished Professor of Finance at Massachusetts Institute of Technology, and the John and Natty McArthur University Professor Emeritus at Harvard University.

He is currently Resident Scientist at Dimensional Holdings, Inc., where he is the creator of Target Retirement Solution, a global integrated retirement-funding solution system.

Prof 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.

Prof Merton is the author of several books. He has also been recognized for translating finance science into practice. He is the winner of many awards, notably, the 2013 WFE Award for Excellence from World Federation of Exchanges and 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. Prof 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.

Prof Merton's research focuses on finance theory, including life-cycle 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 systemic risk.

The Dr. R H Patil Memorial Lecture will be an annual event and we are committed to honouring Dr. Patil's legacy by inviting world renowned thought leaders. I am sure we will all gain valuable insights from Prof Merton's lecture and thoughts and I would like to thank you all for coming.

Inauguration
and lighting of
auspicious lamp

DR. R H PATIL
Memorial Lecture - 2018



Mr. Ashok Chawla (Chairman, NSE), Prof. Robert C Merton and Mr. Vikram Limaye (MD & CEO, NSE) felicitating Mrs. R H Patil (wife of Late Dr. R H Patil on the dais)

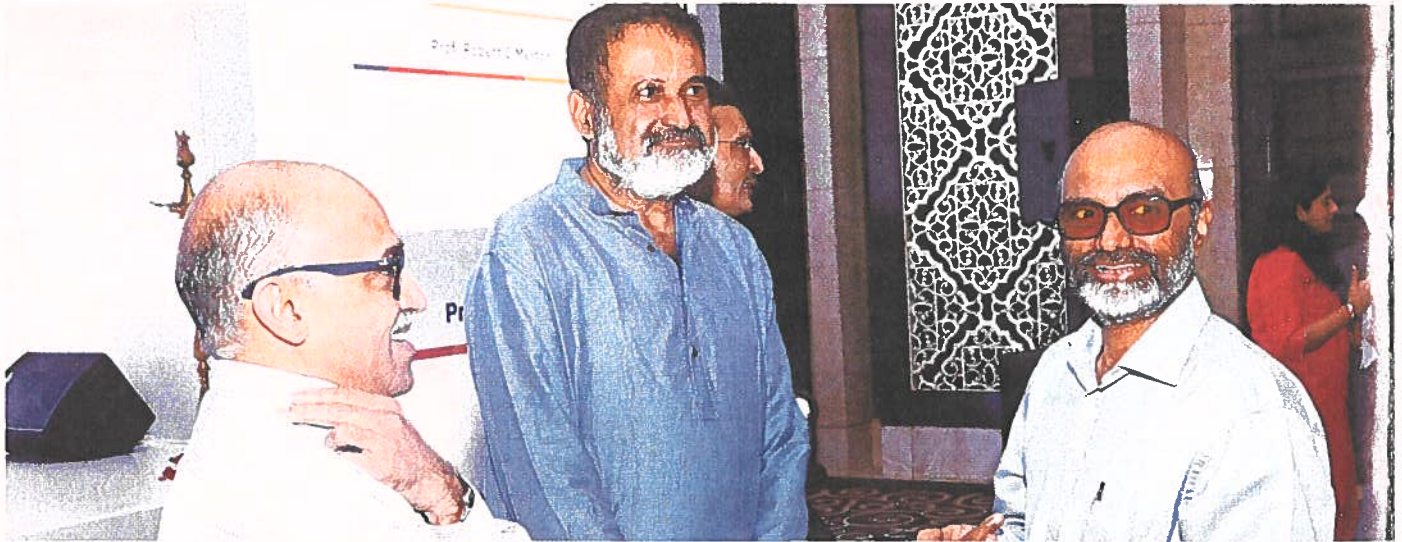
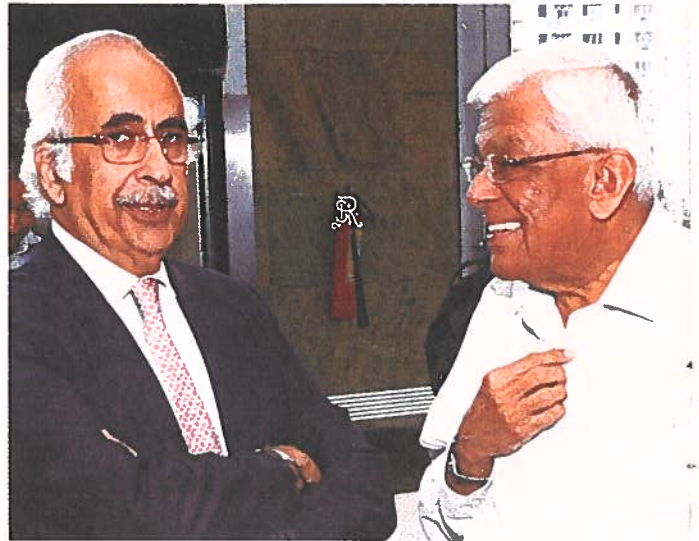
Mr. Vikram Limaye (MD & CEO, NSE), Mr. Ashok Chawla (Chairman, NSE) and Mrs. R H Patil (wife of Late Dr. R H Patil) looking on as Prof. Robert C Merton lights the auspicious lamp marking the start of the event.



Mr. Vikram Limaye (MD & CEO, NSE) lighting the auspicious lamp marking start of the event, also in picture, Mrs. R H Patil (wife of Late Dr. R H Patil)



(Top Left) Prof. Robert C Merton in conversation with Mr. Vikram Limaye (MD & CEO, NSE) and Mr. Adi Godrej (Chairman, Godrej Group). (Top Right) Mr. Ashok Chawla (Chairman, NSE) in conversation with Mr. Deepak Parekh (Non-Executive Chairman, HDFC Group). (Centre) Mr. Pai with Senior Dignitaries. (Bottom). Senior Dignitaries in conversation.



Keynote Address By Prof Robert C Merton

Solving Global Challenges Using Finance Science: Past and Future



Well, let me begin by saying that this is my first day in India. I have never been to India before. I thank you for inviting me to speak to you on this very special inaugural memorial lecture. Let me get started right away. What I propose to talk about is how we can use the Science of Finance.

Finance, as it developed is an organized field to address a number of global challenges, not just for financial services, but indeed more broadly for economics. The way I propose to go about this is, first, I'm going to talk about the past a little bit, to set the framework of how this has

been a practice going on for some time; then talk about financial innovation and how the science of finance is important to economic growth and development. I need hardly tell this audience the importance of finance in the financial system and in economic growth and development. Some of you may have heard the idea of dichotomy; now what do I mean by that? There's the real economy and the financial economy. It is as if these were separable. I'm here to say that that's a myth. It only exists in out of date macroeconomic text books. The relationship between the financial system and economic

growth and development are inextricably linked to one another. And I'm going to give you just one piece of evidence of where that comes from.

My former professor, colleague in MIT, Robert Solow, received the 1987 Nobel Prize for his work on the growth theory. And his innovation and the thing he did was to show that economic growth was not driven by the traditional ideas of frugal saving within society or population growth. But rather that financial innovation was driven by technological progress, because technological progress will drive growth. Now in my University, MIT I have some of the most fantastic colleagues. The kind that said if you get a big head, when you look at what they're doing, it makes your head feel very small. And they're doing wonderful things in the lab. They're doing Life Sciences and nano-technologies. But if that technology does not find its way into the mainstream of the economy, out of the labs into society, it will never result in growth. And the process by which that happens is connected in a very, very direct way to effectiveness and efficiency. The well-functioning nature of the financial system; raising resource, getting resources to the right place to get used. Risks, **you can't have growth, can't have development, unless you're willing to take risks. Risk is fundamental. How you manage that risk, how you place that risk therefore has profound effect on the degree of success that you have.** So even though I don't really need to do it, I felt on this occasion honouring the First Director of the Exchange, this is an important critical element for growth and development.

This is the 10th anniversary of the great financial crisis which I absolutely felt more in my country, than out here. In that environment, the notion of financial innovation, the reaction was slow it down, even stop it. Maybe reverse it. I'm not here to discuss whether that's a wise idea, whether with this was really happening. There have been many retrospectives with this hindsight of ten years to settle that. But what I do want to show you today is that that's not what always happens in crisis.

I'm looking out there, you're a pretty young group. I mean some of you are vintage, but most

of you are a pretty young group. But you've heard about the crisis. What is the 2008-09 crisis been compared to always? The Great Depression. But actually I don't think that's the appropriate comparison. The only common thing I think it has with the Great Depression, is that 2008-09 looks like now, it was a classic bank failure system which we didn't think could happen in 2008 and 2009; now we know it could. But other than that there is a very little comparison. What I think is a better comparison, the one I want to take you back to and look in retrospectively, is the financial crisis of the 1970s. Seemingly a long time ago for many of you. But I was a grown up, I lived in it as well as lived by it. And I want to use this to show you how different that was, show you the kind of impact that finance and finance sciences have on subsequent development.

First I'd mention, **Finance is a science. A science has principles, hypothesis, serious data and a process of assessing those hypothesis against the data in an organized way. Finance does that now. We've had eight Noble Prizes related to their work in finance. So that should be enough evidence.** But what I thought I might tell you, just for few of you who are in the field, is where I think the science really began. I think it started in the 1950s and it started with the work of a man Harry Markowitz whose work on Portfolio Theory introduced the idea of a formal fashion of diversification. Before that finance was a series of anecdotes, rules of thumb, accounting identities and most importantly-no data.

It's hard to believe, for those of you now where you have terabytes of every single trade in every place in the world being recorded. But indeed prior to 50s we had barely little more than the Dow Jones average to look at for anything in the sense of history. And during the 1950s and into the 60s we had the development of diversification, hedging which is the second way of managing risk, Corporate finance, so the work by Modigliani and other work. All these were Noble Prize winners by the way. And then very importantly, the University of Chicago created the first comprehensive data base, going back to the 1920s, of all stocks traded in the United States, an enormous database, to actually look

at the way the world is and not the way the world was in the stories told.

By the end of the '60s, finance was an established science. Database, hypothesis, principles, evaluation in a formal way. I would mention it was a very young science. I should say that Harry Markowitz is not the father of this science. There was no one father. Harry Markowitz is still alive but more importantly Harry Markowitz is still working. So when you mark the beginning of a science for a person who's still alive and working, it's a young science.

I now want to move into the 1970s which came after this. To take you through a story that maybe you all may not know, and I think you ought to know. I am going to start with United States, I apologise for that but this is what I know. **The 1970s is where it started. The major shocks, economic and financial shocks that hit US, and because it was the US, it then had impact throughout the world.** So, what were the shocks that happened in the 1970s? And in no particular order, **the fall of Bretton Woods.** What did that mean? For a generation, 30 years, currencies were fixed. You didn't have to remember anything about exchange rates; they were always a fixed number. For a generation. And suddenly they all came apart. This is a shock of risk to the system. If you are in the trade suddenly you had this whole new risk that you hadn't had to deal with for a generation. What else happened, **we had first the oil crisis. All the way from \$2.50**

to \$14.00 a barrel, we didn't know we had the number but by the end of the decade we had a second one. Pretty big shock. What else was going on in the United States? Really hard to believe these days, you know today we're always talking about how we can get inflation up; we're worried about deflation in some countries. **We had double digit, 10% inflation in the United States.**

We had not seen that since our Civil War in the middle of the 19th Century. A 100 years earlier. More than a 100 years! There was no one alive who had ever experienced this. And what came with that inflation? **Double digit interest rates.** Also something that we hadn't seen. Long term, short term rates, all north of 10%. And by the way it didn't stop. During the 70s, it went all the way into the early 1980s, where we hit a peak, at least in Treasury bill market, where we hit 21%. Can you imagine 21% interest rate on US Treasuries? Hard to believe. But it happened. And you could imagine what this did. There was no money for housing. When I say no money, they had a regulation because banks couldn't pay more than 5%. Now, I don't think you have to be a finance rocket scientist to figure out if you can get more than 10% interest with a tax break from the US Government for raising credit, why would you ever put your money at 5% in the bank? And they didn't. And there was no money in the banks for housing. And that had nothing to do with credit. There was just no money. You could imagine the impact that had. And now I come to this other shock, one that didn't exist during the



2008-2009 crisis. **Along with high unemployment, unemployment in the 70s was 9%.** Now think of that. 10% inflation, 9% unemployment; what do you central banks do? Do you think that the FED, the ECB, Bank of England; you think they could have done the policies they've done with the 10% inflation and higher unemployment. With the 10% inflation and higher unemployment. Called Stagflation. And by the way stagflation comes back, my macro economist friends tell me, we don't know how to cure it. So let's just hope it doesn't come back. What's the purpose? Oh if the stock market fell by 50% in United States in real terms in 18 months, why do I go through this list? **How many shocks of big magnitude all happened at one time? What was the outcome of that?** What was the reaction to that? That's what I want to take you to next.

Unlike 2008-09 where innovation was stifled even reversed, everybody said innovation was just this bad thing, stop it, reverse it, too far, too much, know what? Reaction in the 1970s was exactly the opposite. What it did, was encouraged, in fact drove an explosion of financial innovation. Creation of markets for handling risks, we created an option market. What are options? They're insurance. They insure financial values. **We created insurance market. We created financial futures for currencies, interest rates, equities to be able to manage the risks,** these enormous risks recurring with double digit inflation, double digit interest rates; interest rates could change by 3, 4, 5 % enough to make real estate go bankrupt if you have costs go up by that much.

We created the electronic stock market, we created index firms, which are now taken as standard. I am not going through each one. The United States created its modern corporate pension system. We got rid of the New York Stock Exchange cartel that made institutions pay the same fees, commissions as I would. Could you imagine that today, your big institutions paying the same commission level? So 100,000 shares you pay 1000 times the commission on 100 shares. We got rid of that and that opened up and that was for the institutionalization of the stock market and related markets. We had

securitization. **We created a national mortgage market.** Prior to that we had local financing. Remember I told you there was no money in the banks, for housing. That didn't go over well. So we created a national mortgage market which created a funding base for real estate in the United States that was global. We could access funds everywhere in the world through mortgage markets, through buying mortgage instruments, rather than through a bank and so forth. And I will tell you it's almost 40 years ago to this day, there has never been a time since in the United States where there wasn't mortgage money. Yeah the rates were higher or lower, little tighter credit. But fundamentally there has always been mortgage money. Younger people in my country think that's always the way it's been. No. Creation of that market, not only addressed the issue of the crisis. It addressed the issue permanently. **And that is what I really want you to see from all this innovation I am listing. Namely that they not only address the risk of the crisis, they provide a permanent dividend, a social dividend to societies.** That mortgage market has been paying social dividends to us for decades. The various options in the futures market that were created under duress, have allowed us to manage risks for all of these types and grow for these last 4 decades.

So you see this list of innovations, the mortgage market, the options market, the insurance market, the pensions, I think the evidence is pretty clear. These innovations not only addressed the risks of the time, they were permanently improving society and growth. And the best evidence of that I think is in this room. Your exchange, this country adopted financial futures. You created options exchanges. You clubbed all these markets. Not under duress. You did it voluntarily.

I think that's the best evidence. These innovations on a whole are believed to be once they are an add to the society. I don't think you bring stuff that is destructive to the society; you are voluntarily into it. So on this occasion honouring the founders and first director of this exchange and all the growth drivers to the exchange, I thought it was appropriate to at least look at history and see the impact these





innovations had around the world and the permanent gains they have given. As a context, that doesn't mean by the way, that they cannot be misused, **it doesn't mean that even good things have dysfunctional aspects. I only want to set the record clear for you to look at and see as to what was the overall impact.** And the other is about finance science, none of these innovations, and I had the good fortune to be there; options, exchanges, mortgage markets, none of them could have been done without the mathematical models that were developed. There was no way you could do it intuitively, there was no way you could run these markets or do the analysis without the data and the models. **It was in the 1970s when finance science became inextricably linked with finance practice and to this day the most advanced work in research and academia, both theoretical work and empirical work, was directly employed in mainstream practice. There is no financial institution in the world that can operate without them, there is no central bank that can operate properly without them.**

I will mention here one more innovation, the interest rate swaps, if you don't know what that is, it is like a futures contract which just allows you to exchange the risk associated with floating

rate with fixed rates. Very simple idea, complex to introduce efficiently. The interest rates swaps, forever around the world, eliminated what was the biggest risk in well run banks. The mismatch between depositors, which is the customer that wanted floating short term rates, and borrowers particularly in the 1970s, facing double digit interest rates, who wanted to lock in their cost of going bankrupt. The banks, had duration mismatch, they were borrowing short term and lending long term and perpetually going into insolvency, whenever rates went up, the costs exceeded their revenues, what kept them from going into bankruptcy was forbearance of governments. And overnight that's gone forever. Today you take the biggest, largest bank of the world, you don't know whether they are going to gain or lose with interest rates going up because they can have any exposure they want in interest rates and meet all the client and customer needs. So that completes what I had intended to say to you about the past.

So I want to move from the past, I want to talk about the present. What are some of the innovations of problems and challenges that finance science.

I am not going to talk to you about some theories. I have chosen three, one comes from

China but it also applies here in India, is how you can reconcile public policies or financial or economic policies of stability with growth when they often conflict, that's one. The second one would be an example of using a single innovation in the bond market. In order to address multiple policies with just one bond innovation that's pretty efficient. These are all right now going into the future, this is not past. And then the third, more broadly I want to talk about the implementation of technological innovation in the financial services so called FinTech, that is one of the hardest thing, everybody is thinking about it, I am sure your exchange is, your central bank, every big country is looking into this and the implications of this technology and how it will change financial services. So these are the three that I hope to address.

In light of some discussions I had, I am going to do them in different orders. So I am going to skip the first one, not because I am not going to do it, but I want to make sure I start with what is typical here from what I have heard. By the way I should tell you a little about my own personality, I am an engineer by training, I have a PhD in economics but my mind-set is solution, solving things. So what I am going to talk to you about is our solutions. Sometimes things are not pretty but they work, okay, I accept better, rest is for the Gods, that's the spirit with which I present this to you. **What is one of the problems, these are all global problems by the way, what is one of the big problems, a global problem, it is funding of retirement.** Every country on the planet is facing the challenge of how are we going to fund retirement. My country is ageing very rapidly we have all these baby boomers and so forth, China is aging faster than US, Korea faster than China, Singapore more than Korea, so they are all competing who is going to age faster and will have a big retirement problem soon. It is not just ageing, it is a host of things, this is one of the big challenges around the world, and I just came from Korea where we were talking about this, everywhere it is a somewhat different story but there are some common elements, the common elements are that the funding system is not going to be able to fund anything like a good retirement for people themselves whether it is a national pension plan or whether it is a pension plan together with corporate plans, the

contribution very soon will have to go up, people will have to work longer, there are a whole host of problems when it doesn't work.

I'm not going to go through all of that because you know what the problem is. I won't waste too much of your time and my precious time with you. **Bottom line though is everywhere it is quite apparent that individuals are going to have to become more responsible for a larger part of their retirement.** Those days where we could just leave it to the government or leave it with somebody else and, magically when you get to retirement, it is all taken care of in a good way, if those days ever existed, they are not likely to continue. That is the message that we get from everyone. And so the problem that I want to point is what can you do about it?

Individuals being more responsible causes a whole bunch of problems. Even my fabulous colleagues at MIT, 150 IQ, 3 PhDs, Nanotechnologies; if we share with them 401K plans on retirement and ask them to choose one where they would like to invest in and they have no clue what to do with it. It is not a matter of being smarter, educated, we don't do our own medicine or surgery, and financing is the same thing. **You shouldn't expect that people in their spare time are able to figure out how to do the best investments and what they would do for retirement.** Most of you out here, you are not looking for and thinking about your retirement. You are thinking about growth in your career, why should you be spending your time thinking about that? **So I am going to explain to you a small bond innovation, very small one that is why I wanted to show to you, it is not very complicated, a bond innovation called the SeLFIES.**

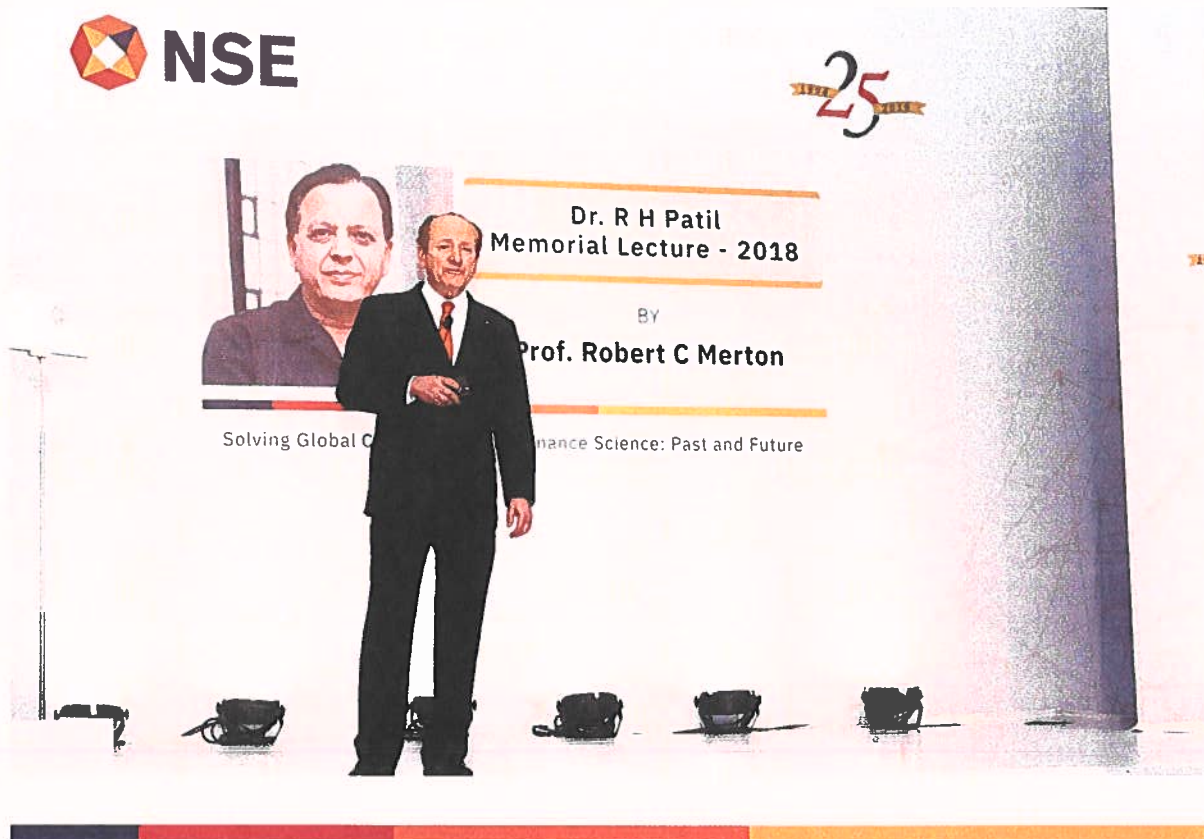
A bond which is designed as a solution to help people in every country, it does not depend on which country you live in. To help people to be able to save for better retirement. And so let me just tell you what a SeLFIE is. First I am going to assume, all of you are familiar with the standard government bonds or pay coupons. You put your money in, you buy the bond, it pays you a coupon like maybe every 6 months for so many years and then you get your money back. A SeLFIE is a government bond, I will explain why government



bond is important. A SeLFIE has a different kind of pattern, you put your money in and it pays nothing for many years, and then when you reach that magic year in the future, it then starts paying a level payment for the next 20 years. So does everybody understand the pattern? First normally you get money out in coupon, then balloon. This is money out and you buy the bond, nothing in the end (pooff!!), okay. So it is the only difference at the moment. That sounds like a strange pattern for a bond. Then actually what pattern is that, this is exactly what every one of us does when we contribute to our pension, we put our money we don't get anything back, when? Not until you are retired. 10, 20, 30, 40 years from now, and then what do you get in a pension, nice level payments at pattern. What we are trying to do here is design a bond that reproduces the pattern of payments of a pension. If we can do that then, if you want to buy get something to create your own pension and help you for retirement, just buy that bond that is the basic idea, there is nothing deeper than that. But let's us look at what that has and why that is a worthwhile thing to explore.

One of the biggest problems when people have to make their own decisions is the knowledge required to make a good decision. I want to

think for yourself, you are all highly educated. So how does a SeLFIE work, suppose I am 45 and I want to retire when I am 65 that is 20 years from now, in 2038, I go and I buy a SeLFIE bond from the government number 2038, they have all different dates like different maturities, the 2038 SeLFIE. What does that do for me, when I buy it, it doesn't pay me anything until 2038 and then it pays me let's say \$5 a year, I am not going to put rupees, you can do it for me; \$5 a years for the next 20 years, I am giving you a concrete example. 20 years nothing \$5 right? Now once I buy the SeLFIE, all I have to figure out is which one to buy, when I think I am going to retire – 2038. Nothing about the interest rates, nothing about compound interest, not about reinvesting, not how much inflation whatever. Just when I think I am going to retire. When I buy the SeLFIE, what do I have to do after I buy? Nothing, why? Because there is no coupon to reinvest, if I had a coupon bond money comes in every 6 months, I would have to invest it somewhere right. I don't know what to do, maybe I expand the money, I don't do the right thing, it is costly. But there is no money coming in so I don't have to do anything. But then what happens we get to 2038 and let us suppose you decide retire in 2038, then what does the SeLFIE do, it starts paying you a certain level sort of payments just like the



pension, you don't need anything more to do. There is no reason to sell or do anything, just wait there, and it starts paying. So do you see, I want you to see this a very simple thing. This minimises what you have to do, what anybody has to do and minimizes the cost and it is very simple and it is do-able anywhere. The people that will use this, are people who have pensions but they don't have enough as in Korea the maximum replacement ratio is 40% that is rather enough to live on, so you are going to have to do more.

For people who really are in unofficial sector who have no pension coverage of any kind, they can do it for themselves and by the way those who are in pensions, so you say I don't need a SeLFIE because my pension will take care of me or my

way, needs to make some infrastructure investments, is that correct? What is the nature of infrastructure investments in terms of the cash flows, money out- money out- money out- money out- money out- money out and the returns from building tunnels and roads and airports come later. So no cash back, in fact, it is cash out for many years. So suppose you are financing your infrastructure with standard bonds, we got to borrow enough money to make all those payments before you start paying anything back for the project, but what else do you have to do with the money? You have to be able to pay their coupons, so you borrow even more money and what do you do? I am borrowing for you to give you your money back, your coupon, does that make any sense? if I went to the bond market, I would say I am not just



insurance company will serve me annually. Your insurance company, if they are going to do it for you, they have a liability to you to pay that. How do they hedge that liability? They promised you, where did they invested? They can buy you SeLFIE and match it up. So it's a good bond not only for individuals, which it was designed first to do, but it's also a great bond for institutions with those kinds of liabilities. So you see it works for both, okay. So not a bad solution, it is simple and it is not that radical.

Well let me show you something else about it, it solves another set of problem. I understand in India like many countries, I hope my own by the

talking about India but I am saying we want to borrow money for 20 years and pay you nothing for 20 years and then we will pay you payments for 20 years after that. How many bonds do you think we would sell today's bond market? Zero, no or may be some; but you know you probably will have to pay them 400- 500 basis points over funding; you know that you have to pay an exorbitant interest rate to get them to do it. And for sure they wouldn't do it in that size. That's not very good. What's the problem? You're going to the wrong people to finance it. Finance one-on-one always teaches us put the money, the risk in the right place and get your money from people who want to lend it to you. Give

them something that they want in return for something you want. That's always a better deal. Then please, I know you don't want to do this but if I pay you enough would you do this for me. Never works well. What have we done with the SeLFIE?

The SeLFIE, 'Standard-of-Living Indexed, Forward-starting, Income-only Securities', is the perfect finance for infrastructure. But instead of having to bribe, pressure, cajole people to buy it, the buyers want that. The people who're saving for retirement don't want any money back. It's just trouble during that 20 years. It's not fun, it's trouble. So what have we done. We've matched a buyer who wants to pattern with an issuer who wants to issue in that pattern. And then when you can do it's magic. Because you get tight spreads and you get great capacity. So what does this illustrate? This illustrates two things, we solve two problems, with one bond.

Financially your country, your debt, Government debt, it makes a big difference if it's foreigner that holds your debt or if it's domestic held. If it's domestically held it's much more stable. If it is the liabilities of the people in the country with the same currency as the bonds they hold. If foreigners hold it you always have this tension if there are runs or lack of financing. So it is a better stable financing of the Government if you could have your own people investing. What do you have? You have a permanent financing here if the SeLFIE works because people will always save before retirement. So I'm just pointing out some of the many features. The last thing I would mention on this, the SeLFIE payments are not fixed in dollars or fixed in rupees. Think about it. \$5 on one bond 20-30 years from now; there's a little thing called inflation, it won't buy probably buy the same thing. So maybe we ought to index it to inflation right, for those \$5 to adjust for inflation; that would be the next step. Is that good enough? No, it's not. Why? **What would be a good retirement I would say for any of you? To be able to sustain the standard of living on retirement that you enjoyed in the latter part of your work life. So that retirement period of your life, you don't have to take a reduction in standard.** We will always like more, taking less is not a good

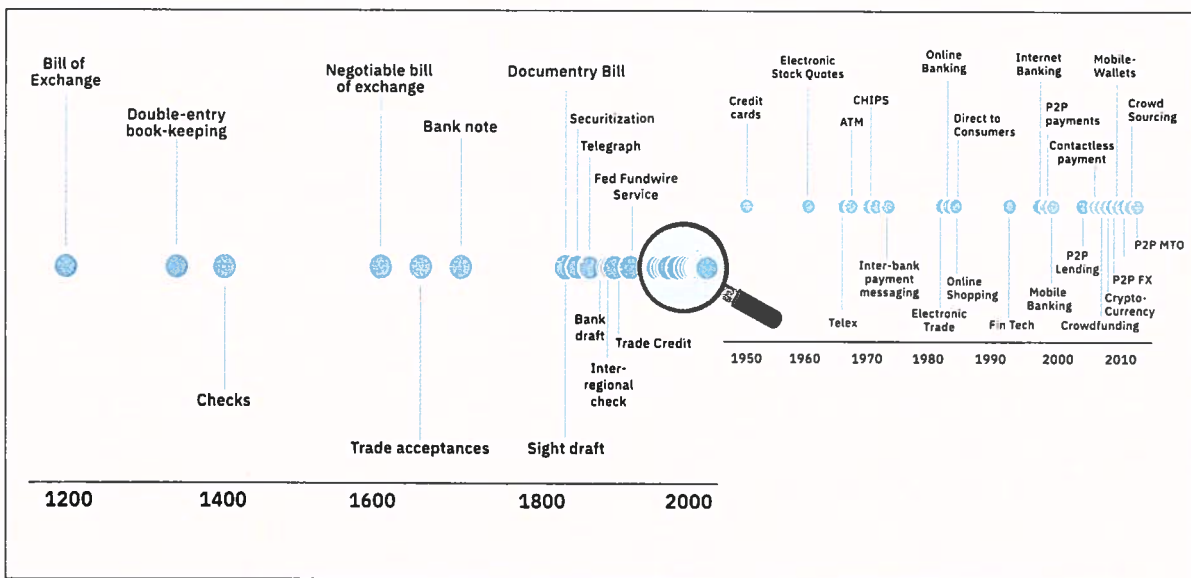
experience. You've worked your whole life. You've got used to how you're living, whether it's this or this or this level and now you have to take a big reduction. That's not a good retirement. I can tell you, I wouldn't want that. And I don't think many others who are here would either. So the problem is even if I correct it for inflation, what's the problem. Think about it, has the standard of living in India or in the United States or in Germany, has it changed over the last 20 or 40 years? So even if you protect it from inflation you may be very disappointed if I give you the same standard of living you have now 30 years from now. You have the electronics that you have 30 years ago, the computer, you have the car of 30 years. You have the travel of 30 years ago. Do you really want to lock that in? I don't think so. So if you really want to give people the right thing you should index that level payment of \$5, not just to inflation but to consumption overall. If you do that, you get both the protection of consumption and inflation, which is the inflation you care about; you don't care about the place of price index inflation, why do you care about that or about what Government expenditures. This is not GDP. You care about consumption, your standard of living, all of us do. **By having it indexed to consumption you get protected against both inflation and standard of living.** And then the beauty is, it makes it even simpler for you to understand your bonds. Now if I say I would need \$40,000 a year from living the standard of living, if \$5 is the payment on these SeLFIE bonds how many SeLFIE bonds do you need for 40,000 a year? Well 5 into 40,000 is 8000. You need 8000 SeLFIE bonds. That wasn't hard, was it? People understand income. They understand what they're making. \$40,000 a year is a meaningful number to them if that's what they're living on. So they know their goal. I need 8000 SeLFIE bonds. Okay? So they know the goal. How about how are they doing along the way? You know that they've been doing this for 10-20 years. How close are you to your goal? Very complicated, you start using compound interest and forecasting. You don't have to. How many SeLFIE bonds do I have? I need to get to my goal 8000. If I've got 3000, I'm only 3 out of 8 there. If I have 7000 I'm almost there. You see how easy it's to know how you're doing.

If you know how you're doing, and you know where you want to go, it's much more likely you'll be able to take actions without having to go to an advisor or have to send a child to learn compound interest computer program so they can solve your retirement problem. But the beauty is, if I protect you from both inflation and standard of living, now you needn't have to forecast that, all you say is Hey! I'm living at 40, **I'll take the standard of living that people have enjoyed, and inflation, I don't need to think about it. It's much simpler.** What's the problem? If there are people in the audience from insurance companies or pension funds, you're probably quivering. The professor is telling people that they should have bonds that are indexed to consumption. How are you going to deliver that product? What asset would you buy to hedge that promise to people that you'll pay them consumption. There is none. Right? So you can't do it. Ah! But what about Government? You do have a VAT tax in India. Right? VAT. What is the VAT? It's a consumption tax. Roughly the VAT revenues divided by the tax raises consumption. Real consumption. **What asset does the Government therefore hold which is a perfect match to the liability of issuing SeLFIE with consumption? The VAT tax, a perfect match. So the Government can make that promise in bond and it's easier for the Government to hedge and deliver them without getting into trouble, that a nominal bond or certainly an inflation bond, cause it has no asset that is directly related.** That's one reason

I want Governments to issue, at least to begin with. They're a natural issuer because they have a natural hedge. If they have a natural hedge, they can issue lots of them all the time. And that's what you need to make the retirement system be practical. So I'm trying to show you that all the pieces fit together. By the way SeLFIE are not being issued by any Government right now. It's an idea that another man and I came up with the help of others. And what we were amazed to find is that, it's all practical, but it's not been done yet. Here you see a Business Times article and it's everywhere in the world, Nikkei, the Economist, Le Monde Paris. They've all picked it up. Why? Because it's striking a chord with people. It's addressing a solution around the world, it's needed and it seems practical enough that they're choosing to put it there. That's what I wanted to end this piece on. It's pointing out to you; we haven't done it yet. But still I've shown you enough details to see that it really can be done. Is it easy? No. is it doable? Yes. Does it address a lot of issues? Yes. And it's just one such example.

Now let me move next... to FinTech.

This picture by the way shows you the acceleration of technologies from the 12th century in finance. So what is the story of FinTech? What comes to my mind is Silicon Valley, these are techies, tech people not finance or economist. They say we are coming for you, for your exchange, for your insurance company,



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

for your bank, we are coming for you and you are going to be disrupted, trapped, you are going to be retired, putting it delicately. And if you work in finance, unless you are old enough to retire pretty soon. You probably should look for a new job, because between AI and FinTech, first will be as smart as the other person and the other, smarter than everyone. By the way this is the same the story they tell in medicine. Doctors need to look for something else to do too, okay. Now that story, it is a story, it is a narrative, it is picked up a lot, scared a lot of people and the others were excited, that story makes assumptions and I am going to pull into question, one or two of those, one in particular about those assumptions and show you a different narrative. Which leads to quite a good story, okay.

First I want to say FinTech, which I have been involved in let us say for a decade, I am a big believer. I think we can have enormous benefits to society, lower cost and I think its impact will be greater for those people who are currently under-served. The others, those who would have been lucky enough to have full financial services, the gains will not be great. But for those in parts of the world or parts of the society who are not well served, or that are with high cost, promissory risk, difficulties in sending money back and forth; I think this is a good thing. Well, like many good things it has its challenges and disruptions, and let me tell you where I think it is the most important one. First, who can be winners and losers and I think it may not be the ones from Silicon Valley. Silicon Valley has the following beliefs, technology is trusted. **Sometimes they say technology is trusted if you are under 40 or 30. Well I'm going to say that it has nothing do with how fast you are with electronics, whether you are a millennial. I would say that trust is not created by technology alone.** Imagine this as Galaxy Note 9, good name right, well known technology, has Google in there, you are familiar with Google? You have heard 'Okay Google'? 'Okay Google' answers questions in 12 seconds. I have a really bad knee, it is killing me, it has been hurting me and given my history maybe it is worn out and now I need to get it re-done. So I go to Google and I say 'OK Google' what should I do about my bad knees? Few second later, Okay Google says "cut it off".

You don't trust Google? Oh! There are some millennial in the room. I can see that. By the way that is a sensible decision, every time I have asked this anywhere in the world I get the same reaction 100%.

My question to you is why? Why are you so sure it would just say that? Well let me help you think about it. This wonderful piece of equipment, 'Okay' is first of all a model. **Everything we do our brains, our computers, our AI are models and what do we know about the models? They are incomplete and that because they are incomplete the right model depends on the right abstractions, right assumptions that are embedded to build the model.** How do I know what medical model was used in that Google device, I don't know. May be it was something, someone went to internet and just got something of the internet, to say under these conditions you don't know what to do, so just cut it off. You don't know the quality of the model, you don't know if it is a good model or a bad model. What else you don't know? **Models pick data and then feed them to it. Is the data used complete? Is it dirty data? Biased data? Error data? What was the motivation for building this thing? Whoever build it, they chose a model, they chose the data, what was their motivation? Was it making you get good advice for your health or is it something else?** Maybe it was a body parts company, he is trying to get a supply, I don't mean to be so cruel with you but it is the way to get your attention, because people worry more about their medical, than even finance. And I am taking you through this exercise so that you think for a moment, because this is relevant to all of FinTech. **You can't get around, the model and the data and the motivation.**

Now if things are transparent? We need to fully see it in order to understand it. That is okay, **I just look at two things and if they are identical and they are transparent, they are the same I pick the cheaper one whatever. And the other way to do it is through verification.** This machine I don't know how it works, but if it is a payment system I can try payments, you know I run a payment through, it works. I try it again, my friends do it and everybody did. So well I don't know it is not transparent, but it seems to work, I can verify it works. Then maybe I will use it. But

there are whole parts of finance, in fact the most important parts with finance, so the most value added parts of finance that can be made transparent and so is also true with medicine, **I can show you data here, if you hired me to manage your money, how many years will I have to manage your money before you can get a statistically significant statement that I am a good manager or not.** There is a mathematical formula for it. So it is not my judgment.

3 years, 5 years, 10 years, I would either have to lose you 12% a year, every year for 5 years or make 42% here for 5 years in order for you to get a significant statistics in 5 years. Does that look likely to you? Losing 12% every year for 5 years or making 42%, what does that tell you? Answer is somewhere between 40 and 400 years. I know you don't like that but that is....by the way an AI machine – artificial intelligence which has no emotion, it is going to that formula and will give same answers. So it is not like you are going to be better from an AI machines. What does that tell you? It is a practical matter, that kind of advice is not verified.

If something is not transparent and can't be made so and if it is not verifiable, **there is only one answer how you can do it and that is trust**

and also confidence and if you don't have both, you can't do this part of finance and technology. I just showed you it didn't work because, I gave you great technology great name, but none of you would follow what it told you. But if you trusted technology, just trusted it, you would. You are not close to doing that, it is far from any reality. **So for FinTech to work, you have to have trust. And the trust asset, who has is it and how they get it, is complicated but if you have the trust asset it actually gets more valuable with technology.** Not less, because as I just showed you, technology gives you surety of more efficient answers but you know it is at the cost of greater opacity. This machine is more opaque than doing hand spread sheet. Spread sheet, you know what you are doing, you take your client data you put it in, it is transparent to you. This machine is not; so the cost always is **you have to substitute for the benefits of technology with greater opaqueness. Greater opaqueness means the trust asset is more valuable.** What is that telling you? You have two factors of production at least, technology but also trust.

If you go back to your first course in Economics, if you took one, you learned that the output is shared by the factors of production. My question

to you is how much goes to the trust asset, versus how much goes to technology, I am not going to answer that. It is a question for you to contemplate. I would mention that technology is highly competitive industry as fast as you make an innovation; three others are going to try to get one better than yours, there is really no barriers to entry. So if technology is a competitive industry is trust a competitive industry? Takes a lot longer, maybe not. And we rely on trust that is what we have regulators for.

They help to create part of that trust. We have to have trust. **So my message to us, given the times that follow, FinTech is**

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

Source: Copyright@2018 by Prof. Robert C Merton

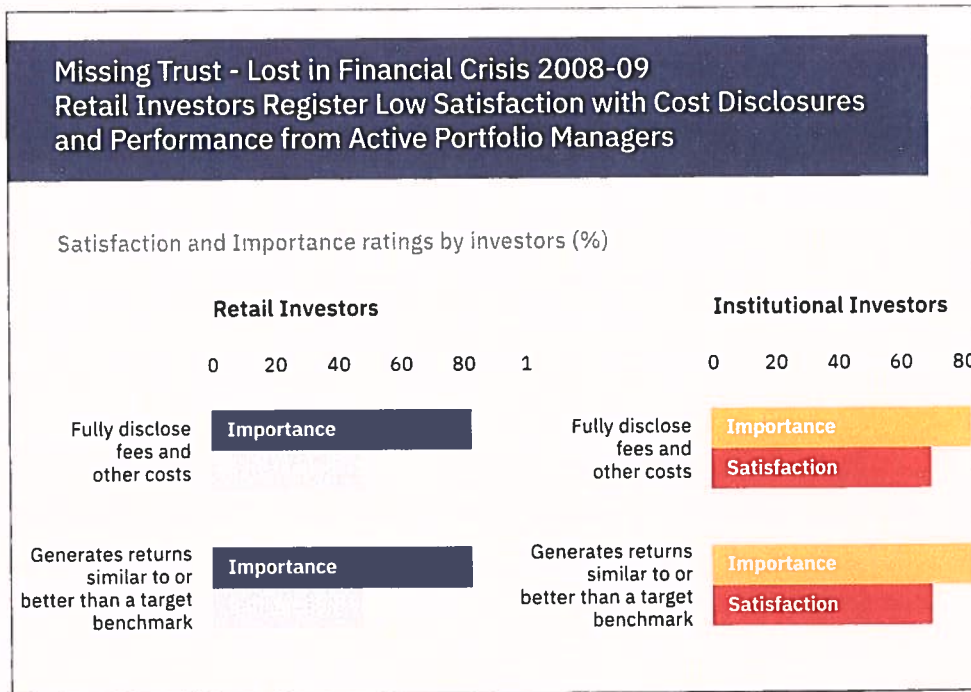
going to happen, it is going to be useful but it is not clear who is going to be the big winner or not and how it will evolve? These big old fashioned banks, insurance companies some of them have a lot of resources, lots of capital and what can they do with it? They can buy any technology out of Silicon Valley again. So they could create the same high-level of technological service as anyone, except what is the difference? I have a choice of having my banking, my investments fund, or my banks or any adviser who has an established record, who is regulated, who has capital and if the things go wrong you can sue him, you can go after them, in effect if they are managing your money maybe it is not a good idea for you. But you trust them, because if you didn't trust them, they wouldn't be managing your money. So if I am your money manager, you trust me. I have your trust asset, do you see my point. **Not all firms are going to be able to adjust, some firms are not going to be able to reorganize themselves to do with the new technology, to deliver services more efficiently. Well but that is not what matters, are there large institutions that can? And if they can, they maybe the big winners because they bring both the trust and technology.** Now

I am not saying that is what we will have, I am trying to stimulate you, if you have been thinking about this, to consider this fairly different narrative, just recognizing the trust asset is incredible. So many of the financial services

don't have it. You don't have it, it won't work. And once you have it, who gets it, who will do interesting things will be considered. Now I wanted to say one thing, I wanted to point out about trust, how important it is, I could show you

some data. I think most people would agree that great crisis of 2008-2009 had a huge loss of trust among everyone, trust in financial providers and trust in their regulators. In the financial providers alone, I won't name them, but you know they were very famous big banks that created fictitious accounts for people and cheated them basically, that is loss of trust they are not trustworthy. Those big banks often had senior management who did not understand the risk in their own institution. That is incompetence. Both elements of trust, it wasn't just the providers but also the regulators, regulators refused to believe and allowed themselves to be captured, not acting in the interest of the people who they were supposed to serve. That is loss of trustworthiness and when regulators were told, they said that they didn't have the resources in order to understand the risks of what they were overseeing, that is incompetence. So I think that is pretty clear. But I want to show you some data and implications of what trust shares.

This is a survey by the CFA Institute taken this



Source: CFA institute. Copyright ET April, 2018.

year between retail investors and institutional investors. What is important to you? Top-line shows 'full disclosure of fees and other costs' are very important, both to the retail and to institutional investors. What was the other one?

Performance. 'Do you generate returns, good returns'? Very important, to the retail what was their satisfaction? Terrible. Institutional are very different. Institutional investors also thought of other things, but for the most part they were satisfied with what they got. So retail investors, just based on the survey, were pretty unsatisfied, that is consistent with loss of trust. That is the first piece the second one is this chart. This shows that in the United States, and which you find around the world, the growth in assets being managed, the top piece, the powerful piece is Index firms and ETFs. These are funds in which investments are made in a fixed, mechanical manner. The investment strategy does not need any decisions. That is something which is transparent, you can see what it is and you don't have to trust people with it because they are not doing anything and you can monitor them, it is verifiable if they did it. **So the strategies of indexing is both transparent and verifiable and because your money is with the custodian, you don't have to trust the company.**



Vanguard is a great company, it's famous for its indexing. You don't have to trust Vanguard, it's transparent, verifiable and they don't make any decisions for you in index fund, even though they are trustworthy. The bottom line shows the flow of assets under management in retail US

funds, through active managers. Those are people who make decisions, those are people who cannot be made non-transparent, and they are the ones that you have to trust to use them. This is after 8 years of bull market. So, this is not just right after the crisis. A trillion dollars flows out of active money and into this index money. Now you might say that people don't think active investors can bear their fees; that was about a decade ago, that won't explain this big change. There's no reason that suddenly overnight people have decided that active managers cannot earn their fees, I don't think that is a plausible hypothesis. The fees are lower, moving down for decades, but what if trust was lost. In 2007, there were some investors who believed that active managers could do better and some investors who thought they couldn't. The ones who couldn't were already in indexed, they were already in that and the ones that could were active. What could have changed is what if the people who were in active managers, who require trust, lost that trust, not because they believe that it could not be done, they no longer trusted the ones who were managing it or the regulator supporting it. **If you don't have trust, you cannot do it, but you can't stop investing right, you still have the same in invest. So, what do you look for? You look for a strategy which allows you to invest without having to trust. What is that strategy, indexing. Is it the best strategy, a lot of people wouldn't think so? Is it a reasonable strategy, yes, Warren Buffet who is hardly into indexing once said that if his widow is indexed, she will be fine. So, it is a good strategy but probably not the best, but if you don't trust, this is the only one that you can follow. If I am correct and I am not saying that I am, I am just showing you the data that this is what happened. We are talking about a trillion-dollar swing in both directions. So what I am trying to communicate to you is that this **trust issue is very big and very influential and it will change people's behaviour** if you have lost it and how you can restore it.**

What do I want to tell you, I am telling you that bringing in this science, looking at the data with me today, **we will get to a better place with FinTech but don't just believe the narratives that one person gives you, without examining**



the assumptions under which they have reached that narrative. I hope that at least in this domain, you will consider that maybe this story, that technology is the thing to trust, that is all we need, may not be a good model, even close to a good model, for how the world actually works or how the world is likely to evolve and therefore in either using it, planning for it, investing in it, give consideration that there are other players, other stories that may even be more compelling, but lead to quite different results.

So, I will leave on that simply because of the time, I would mention just one more before coming down. Block Chain, is that the one you all heard right, Block Chain doesn't need trust, Block Chain is the answer to everything, we don't have to trust anymore. How can we use what I told you to look at Block Chain in general? It's not about stock markets or advice. **Block Chain is a concept. The Block Chain that I offer you is a real-world product, it's a model. Whose model is Block Chain, who built the Block Chain model that I am offering you. What was the motivation of who built it, did that person make a trapdoor, which at the right time they can open and take all your money out, that's not trustworthy is it. How do I know? Whose model did we use to build the Block Chain? Is it a flawed model or a good one? What data are used in that model?** See, it's the same story. What I leave you with is that there is no free lunch. Everything is a model and whenever someone says that I have built something that can't fail, get off that boat or plane because everything is a model, therefore everything can fail. **For anybody to give you a complete answer, they should tell you how do we deal with it when it fails. Ask that question.**

The other is that models involve judgement, that's the art of every science, it's not just true of economics, and it's true of physics, chemistry and life science. When they got DNA, they had to make assumptions, they had to make abstraction, so its complex work. There are abstractions that turn out to be pretty good ones, people who made the wrong abstractions didn't get there, so never forget this. It is true of AI models as well, that it is not complete,

therefore you always have the art, also we are having to deal whom do you trust and that's an element that is foundational.

I thank you very much for your attention, I didn't get through all three, maybe because I was spending too much time on the ones that I did because I wanted you to get the flavour. As I step down finally away from you, think about it. Did you ever hear a song you liked, you know, song, when I find a song I like and the first time I hear it, it hits straight, she is singing, she has gone 'papapap', I don't know one word she sang but I liked the song. So, I put it on my thing, the repeat thing that keeps playing the song over and over again and I play it, I play it, I play it, guess what, by 20 or 30 times, I know every word she is saying by repetition. In that spirit, you share with me, your evening with me, in my inaugural day in India, I hope to be welcomed back again, if you hear me enough times...

[Applause and laughter]

Thank you very much!

(minimally edited version)



Prof. Robert C Merton and Mr. Vikram Limaye (MD & CEO, NSE) interacting with the media.

NSE

Media Interaction

with

Prof Robert C Merton



Alfred Nobel Memorial Prize in Economic Sciences,
School of Management Distinguished Professor of Finance,

NITIE Sloan School of Management; Resident Scientist, Dimensional Holdings, Inc.



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Media coverage of the event

Times News Network

Infra bonds can help funding after retirement: Merton

TIMES NEWS NETWORK

Mumbai: Robert C Merton, the Nobel Prize winning economist on Monday, suggested long duration bonds for infrastructure could be the right solution for the retirees in countries like India. Merton is famous for his work on pricing of options that won him the Nobel Prize in Economics, jointly, in 1997.

He explained that the pay-in periods that prospective retirees look for during their working years fits well with the long gestation for infrastructure bonds till the payback from them starts.

Merton, who teaches at Massachusetts Institute of Technology, US, was in India at the invitation of the NSE to deliver the Dr R H Patil Memorial Lecture in the city.

Funding the retirees' need for funds, when they stop working, has been one of the biggest public policy challenges globally, and so is securing funding for long-term infrastructure projects. "By just changing the bond market design, we will be able to address these public policy challenges that are global," he said.

Merton's solution is the bond variation called SeLFIES (Standard of Living Indexed Forward-starting Income-only Securities). Here, the government issues bonds that will pay nothing during the initial period when the infrastructure is being built. The bonds will start paying only after say 10-15 years after its issuance, which is once the infrastructure is built and the payback starts. This is also the time when the retirees' need money. So, the future retirees will buy these bonds now knowing well that they will not get anything when they are working, but will start getting higher payouts than the regular, interest paying bonds once they retire.

"Basically, we synthesise your pension but by doing this with a bond," he said. "What we are going to do here is you put your money in, you get nothing (during initial years and) then in a given year you get a level payments and then it stops at the end." The structure of SeLFIE bonds is such that it can protect retirees from both inflation and a fall in the standard of living after they retire.

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ROBERT MERTON'S RETIREMENT ON A SeLFIE STICK

It is a little surreal to hear an economics Nobel Laureate flag issues and provide solutions to some issues that personal finance writers across the world have been puzzling for many years now. The occasion was the R H Patil Memorial Lecture to mark 25 years of the National Stock Exchange. Patil was the first Chairman of the exchange that was set up in the aftermath of the 1992 stock market crash. Delivering the lecture was Robert C Merton, Nobel Prize-winning economist and professor of financial MIT.

It was surreal because personal finance writers have flagged issues around trust, asymmetric information, product design, retirement planning being rocket science, to name a few. Surreal because the financial sector, regulators and policy makers have pushed back at ideas around product design and other supply-side solutions to focus on the issue and financial literacy of the demand-side solutions. Inherent in their push-back is the passing of responsibility to consumers of retail finance. I have long believed that it will take product design and supply-side solutions to solve this problem.

Merton's entire talk was about solving some of these issues from the supply side. He was dismissive of financial literacy saying that it is better to design a car that you can just drive rather than teach hundreds of internal combustion to the driver. He says that it is better to design products that an average person can plug and play rather than hold

them accountable to learn finance and evaluate products—especially for retirement. This is important because academic informs policy, Policy directs regulation, Regulation constrains markets. Markets design products that you and I buy.

Merton's latest work is around product design in a government bond that will allow an average person to target her retirement. The solution is called the Standard of Living Indexed, Forward-starting, Income-only Securities—or SeLFIES. This is a government bond that begins to pay interest after a certain number of years, for a certain number of years. The buyer targeting her retirement will have to make two assumptions—the year of retirement and how long she will live. Assume that a 10-year-old in 2018 decides that she will retire in 2038. She currently spends ₹2 lakh a year and would like to maintain this standard of living in real terms when she turns 60. She would also like to have a product that looks after inflation during the 20 years she plans to live post retirement. Merton's solution is to have a deferred interest-paying bond that you can buy in 2018, with the payouts beginning at retirement. The payouts will be indexed to a standard of living index so that buyers don't see a drop in their lifestyle. The payout of these bonds, says Merton, is exactly the cash flows that a typical infra project throws up—a long investment period with no cash returns and then an annuity of returns over the life of the project. Long-term infra projects can be funded by these bonds. What about the hedge for the cost of living? Merton believes that the GST will provide a natural hedge for the product. You can read more about the product here: [Infra SeLFIES and how to take 'SeLFIE'!](#)

What if the government sold us a standard of living indexed pension bond?

The issue that we with such a product is the probability of government in a pre-election year raise the money to fund a long-term infra projects that don't generate the returns needed to fund the payouts in 20 years. Take for instance the pushing forward of bank NPAs by the IFA government. Merton says that governments always tend to make good their promises. But I would still worry about a malfeasance of kicking the can down by an irresponsible government.

Another issue flagged at the lecture was of trust. Post 2008, retail investors in the US have lost trust in the financial sector and managed funds. \$1 trillion have since left for unmanaged funds to provide funds over the past few years. Merton believes that the time for low-cost advice is here and that is the only way trust can be established. Commissions, whether in cash, kind or any other way, open the road not to conflicts of interests and it is only the pure fee for advisor that will win the trust of investors. The Indian market regulator has been grappling with the issue of advice versus incidental advice in distribution for a while now. Inputs from Merton may give some clarity on the way the academic world is looking at the issue now. As I said earlier—the impact of an academic is finally on market design.

The next step in this story will be to turn the market from being a retro-seller beware in retail finance. We wait for that to happen as academic gives us the evidence to something we know from practice.

Monika Halan is consulting editor at Mint and a retired household finance, policy and regulation.



How to get regular income after retirement
By Monika Halan



RETIREMENT FUNDING

Merton suggests bond innovation for individuals in China, India

ENS ECONOMIC BUREAU
MUMBAI, OCTOBER 15

NOBEL PRIZE winning economist, Robert C Merton on Monday suggested a bond innovation called SeLFIES (Standard of Living Indexed, Forward-starting, Income-only Securities) for retirement funding of individuals and infrastructure funding for countries such as the US, China and India.

Merton, while delivering the 15th annual Dr R H Patil Memorial Lecture in Mumbai, organised by the National Stock Exchange

(NSE), said funding of retirement is one of the biggest global problems and individuals need to become more responsible for their retirement and rely less on the government pension plan.

Merton said SeLFIES start paying investors upon retirement and pay real coupons only indexed to aggregate per capita consumption—for a period equal to the average life expectancy at retirement. Instead of current bonds in global markets that are either nominal or indexed solely to inflation, SeLFIES cover both the risk of inflation and standard-of-living improvements



Robert C Merton, in Mumbai on Monday. Ganesh Shirsekar

said Merton. "SeLFIES minimises the cost and the people who use this

could include those that don't have enough pension or people who don't have pension. It is a good bond not only for an individual but also great for institutions such as insurance firms," said Merton. "SeLFIES are designed to pay people when they need it and how they need it, greatly simplify retirement investing."

Merton said that infrastructure spending mostly requires large cash flows upfront for capital expenditure, followed by delayed, inflation-indexed revenues, once projects are online. SeLFIES, according to Merton, is

the perfect way of funding infrastructure projects.

On Fintech, Merton said that truth is essential for Fintech to succeed and Fintech's success will enhance the value of trust. "Fintech is going to happen and it will be useful but it's not true who are going to be the big winners in this and how will it evolve," said Merton.

Merton, who won the Nobel Prize in 1997 for a new methodology to value derivatives (Black-Scholes-Merton model), is currently actively associated with various fund houses including Arbitrage Management

Company (AMC), Long Term Capital Management which he founded and Dimensional Fund Advisors Pte Ltd. His research focuses on finance theory including life cycle finance, optimal inter-temporal portfolio selection, capital asset pricing, pricing of options, risky corporate debt, loan guarantees, and other complex derivative securities.

The Dr R H Patil Memorial Lecture is organized in the honor of its founder and Managing Director, of NSE, Patil, who played a pivotal role in transforming India's capital markets.

The Mint

FUTURE OF CRYPTOCURRENCY

'Only govt control can make it legal tender'

Vivina Vishwanathan
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MUMBAI: Nobel laureate economist Robert C Merton's prediction for cryptocurrency is that only government-controlled digital currencies will be legal tender. The economics Nobel laureate was in India for the R H Patil Memorial Lecture on the occasion of National Stock Exchange's 25th anniversary.

Merton, in his presentation, explained that legal-tender fiat currencies have intrinsic value because they can always be used to settle government obligations of taxes and fees (\$4.8 trillion annually in US) and all legal-tender-denominated private-sector financial obligations. "Digital currencies that are not legal tender do not have such an intrinsic value. The viability of any currency depends on collective trust by its users and lack of any material intrinsic value is a prime source of its instability," he noted.

Because governments hold the ultimate responsibility for failures in their payment systems, it is difficult to imagine their accepting as legal tender any currency that was not under their control, including controlling unobservable flows into and out of their jurisdictions by criminals and terrorists, he added.

Governments have the power to effectively ban the holding of any legal-tender currency surrogate. Take, for instance, the US's ban on ownership of gold prior to 1971. The imposition of such a ban is a major risk to all non-legal-tender currencies and a source of instability.

But not everyone agrees with Merton's view. "The mention of legal tender in the context of crypto-currency only serves to confuse the issue. Effectively, it is like saying only that which is government-approved will be legal tender. The incorrect message that gets conveyed is that somehow cryptocurrency is not legal. The shallowness

HOW TO USE ATM FOR CRYPTOCURRENCY

Last week, Unocoin, a cryptocurrency exchange platform in India, launched a Kiosk in Bangalore. In India, regulations come much later than the ones from developed countries. Given that our customers did not have a mechanism for cash-in and cash-out, this was essential," said Satvik Vishwanath, chief executive officer of Unocoin. You can deposit rupee notes in the kiosk. The minimum amount for deposit and withdrawal is ₹1,000, and the notes must be in multiples of ₹500.

HERE IS HOW IT WORKS

TO DEPOSIT MONEY
Step 1: You need to have a Unocoin account. To deposit rupee notes into the account, you need to enter your ID and the one-time password (OTP) which will get via SMS on your registered mobile number.
Step 2: After you confirm the account details, you can deposit the funds into the Kiosk machine. Your account will get updated with the deposited funds to buy cryptocurrency.

TO WITHDRAW MONEY
Step 1: You have to make a request by visiting the website or through mobile app where you desire to get the amount for withdrawal.
Step 2: You will get a 1D-digit reference number. You have to enter the reference number and OTP that was sent to your registered mobile number at the kiosk.



*Nobel laureate economist Robert C Merton

believe in Merton's prediction. "Government-controlled legal crypto tender (national currency) will be the future for sure, but decentralised global crypto currencies will also exist and law for legal tender will have to be altered to address the same," said Praveen Kumar, chairman and CEO, Beitricks Global SDH, a company that operates bitcoin exchanges in Singapore, Malaysia, Bahrain, Japan, Kenya, Nigeria and Tanzania.

In the context of blockchain, the technology used by bitcoin, Merton said that it cannot succeed unless it is accepted and trusted. Determining ownership—clearing and settling transactions—is a fundamental function in both, finance and real estate. Blockchain offers transformational potential for a non-centralised, efficient, low-cost and highly reliable method for clearing and settling transactions. However, questions on motivation, quality, security and reliability still remain unanswered.

Nobel laureate floats 'SeLFIE' as solution for infra funding

Deferred-coupon debt instruments could help address asset-liability mismatch

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Professor Robert C Merton, laureate with the Nobel Prize in Economics

Infrastructure financing is a perennial problem for governments. The conventional approach is to issue debt instruments with a maturity that matches the life of the infrastructure project. But this approach is often criticized for being too expensive. Nobel laureate economist Robert C Merton has proposed a solution called 'SeLFIE' (Self-Liquidating Financial Instrument). SeLFIEs are debt instruments that have a maturity that is shorter than the life of the infrastructure project. They are designed to be sold at a discount to their face value, and the proceeds are used to fund the infrastructure project. The SeLFIEs are then used to pay for the infrastructure project, and the remaining proceeds are used to pay for the interest on the SeLFIEs. This approach is designed to be more cost-effective than traditional infrastructure financing.

Economic Times

Financial sciences are rapidly making strong strides to play a larger role in economic growth

It's Totally Worth the Risk



Robert C Merton

There's the real economy and then there's the financial economy. The financial economy is not just about the stock market, it's about the entire system of financial institutions and instruments that support it. The financial economy is a complex system that is constantly evolving. The role of financial sciences is to understand this system and to develop new instruments and strategies that can be used to manage risk and to create value. The financial economy is a source of both opportunity and risk, and it is essential to understand it in order to succeed in the modern world.



Financial sciences are rapidly making strong strides to play a larger role in economic growth. The development of new financial instruments and strategies is essential for the growth of the financial economy. The role of financial sciences is to understand this system and to develop new instruments and strategies that can be used to manage risk and to create value. The financial economy is a source of both opportunity and risk, and it is essential to understand it in order to succeed in the modern world.

Fintechs are No Challenge to Behemoths: Nobel Laureate

Technology by itself is not sufficient to create trust, says Robert C Merton

Our Bureau

Mumbai: Fintech companies from the Silicon Valley can enable betterment of services but the belief that they can be a threat to established institutions such as banks and investment advisory firms is a myth, said an Economics Nobel Laureate.

"Trust is essential for user adoption of financial services. Technology by itself is not sufficient to create trust," Robert C Merton, professor at Sloan School of Management at Massachusetts Institute of Technology, told the audience at the RH Patil memorial lecture.

Those who have the trust will find out they are not going to be pulled out of business by technology. (But) they are going to become more valuable with technology." The assertion by Merton, who had played a key role in the development of the rational school of economic thought, should come as a reality check for many investors and entrepreneurs who have been betting that financial technology could challenge big banks.

Fintech with technology alone will be challenged in disrupting services and products that are "inherently opaque (that is, cannot be made transparent) such as financial advice, solutions and many integrated financial products. The core means of providing those services and products is through trust," he said.

Merton was among renowned economists who developed the options-pricing model, along with peers Fisher Black and Myron Scholes, which became the tool for

Wall Street to develop exotic derivative instruments. Although they served the purpose of hedging risks, unregulated mushrooming of derivatives was blamed for the 2008 financial crisis.

He also advocated a new bonds scheme called 'Selfies' to fund pension plans and infrastructure in countries like India which lack long-term funding for projects. Such bonds are very long-term in which returns are linked to the standard of living and the coupon is payable only after a long period, say 10 or 15 or 20 years later.

ROBERT C MERTON
Professor, Sloan School of Management, MIT

Those who have trust will find out they are not going to be pulled out of business by tech. (But), they are going to become more valuable with tech

A financial ecosystem to meet India's aspirations





NSE

National Stock Exchange of India Limited

About NSE

NSE is India's leading multi-asset exchange which enjoys significant market share leadership in Equity, Equity Derivatives and Currency Derivatives. Recently NSE has renewed its focus on developing India's nascent Debt Market and grow the Commodities Derivatives market.

Globally, NSE is ranked as number 1 in Index options contracts traded and number 2 in Equity trades, Stock Futures contracts Currency Futures and options contracts as per WFE data Aug 2018. NSE is also the preferred exchange for global investors to invest in Indian markets and enjoys an overwhelming share of global inflows into Indian markets.

NSE has a fully-integrated business model comprising of exchange listings, trading services, clearing and settlement services, indices, market data feeds, technology solutions and financial education offerings.

NSE intends to play a key role in the development of India's markets and in providing the products and infrastructure to fund India's growth through better intermediation of savings and providing access to capital to our country's companies and entrepreneurs.

Guided by its purpose of improving the financial well-being of India's people, NSE is committed to support and help India in its aspirations to become one of the world's leading economies.

