

Where The Numbers Meet The Road – Uncertainty At The Frontiers Of Finance

Professor Michael Mainelli
Executive Chairman, Z/Yen Group

Calculating & Communicating Uncertainty Conference

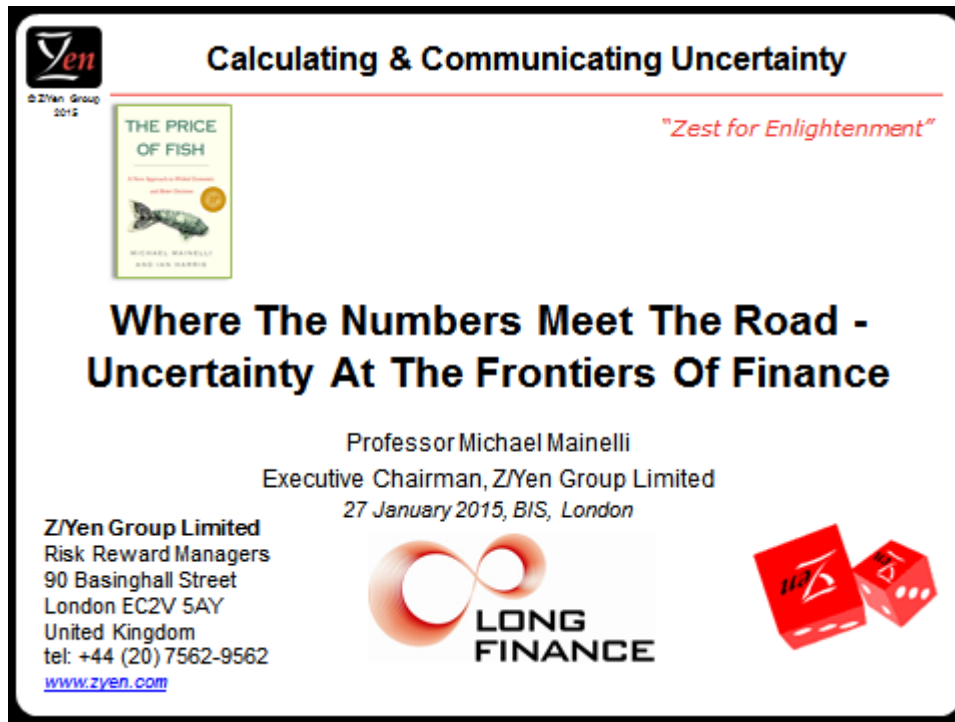
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BIS, London

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Calculating & Communicating Uncertainty

"Zest for Enlightenment"


THE PRICE OF FISH
A New Approach to Market Uncertainty
MICHAEL MAINELLI AND IAN HARRIS

**Where The Numbers Meet The Road -
Uncertainty At The Frontiers Of Finance**

Professor Michael Mainelli
Executive Chairman, Z/Yen Group Limited
27 January 2015, BIS, London

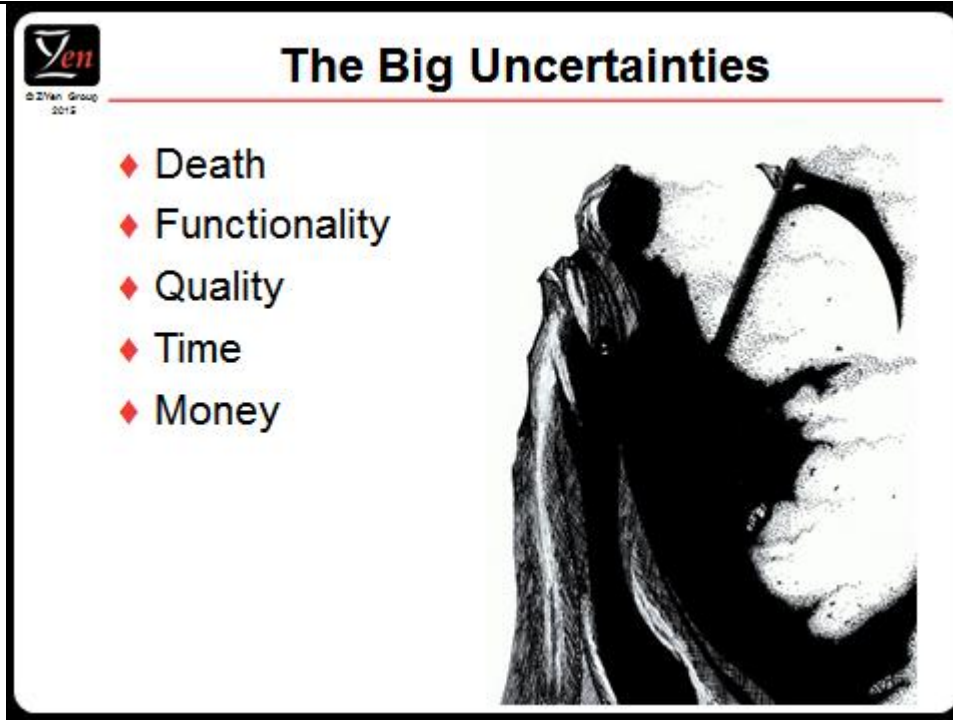
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LONG FINANCE



Good morning. Mark Twain knew the secret of success - "All you need in this life is ignorance and confidence; then success is sure."¹ This entire conference is about confidence, so I shall try and give you ignorance, lots of ignorance about money. I want you to think about money as a technology, about money as a social construct, and use money as a measure of value only with great trepidation.

¹ Samuel Clemens, 1835-1910, Letter to Mrs Foote, 2 December 1887



The Big Uncertainties

- ◆ Death
- ◆ Functionality
- ◆ Quality
- ◆ Time
- ◆ Money

Uncertainty isn't bad; sometimes we like surprises. Without uncertainty I wouldn't have found love, we wouldn't enjoy most art, literature, or music. We care about uncertainty when the surprise hurts. I'd postulate five big, negative uncertainties - death, functionality, quality, time, and money. We want to know something won't kill us, and works, stylishly, in a timely manner without costing the earth. For analysts death is perhaps easiest to evaluate. But the minute we compare individual deaths or add functionality and quality and time to the calculations, these evaluations become labyrinthine. Think of quality adjusted life year analysis in health. And then there's finance.



2,000,000 Years of Commerce & We Still Don't Know The Price Of Fish

THE PRICE OF FISH
A New Approach to World Economic and Other Decisions
MICHAEL MAINELLI AND IAN HARRIS

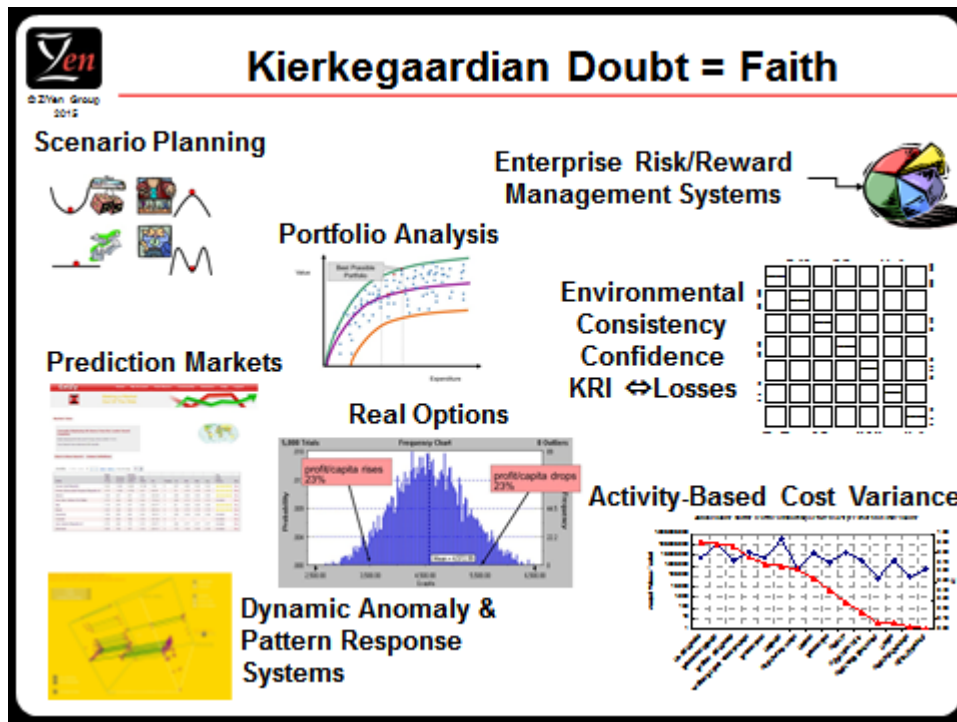
Choice

Economics

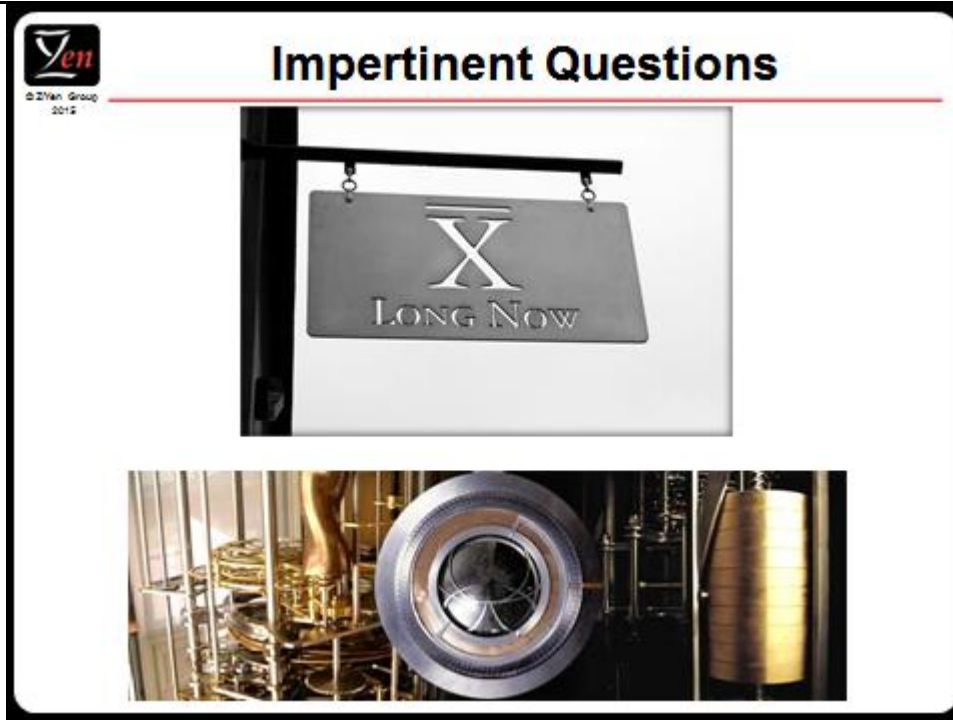
Systems

Evolution

Back in the early 1900's, on rumours that sardines had disappeared from their traditional waters in Monterey, California, commodity traders started to bid up the price of tinned sardines; a vibrant market ensued and the price of a tin of sardines soared. A classic bubble. One day after some successful trades a buyer chose to treat himself to an expensive snack; he actually opened a tin and ate the sardines. They tasted awful and made him feel ill, so the buyer called the seller and told him the sardines were no good. The seller said, "You don't understand. Those are not eating sardines, those are trading sardines." Ultimately, sardines off California were fished out by the 1950s. Anyone for CDOs?



Søren Kierkegaard related risk to faith. "For without risk, no faith; the more risk, the more faith." Up in the City of London we have a supply a lot of doubts and consume a lot of faith applying different techniques to risk. Some of them old hat, some new. Some have been taken from other industries, e.g. from Six Sigma manufacturing using cost variance as a measure of operational risk in financial products. We have tried deploying some of our techniques in other areas, e.g. portfolios and real options to R&D, or enterprise risk/reward management mutuals to Ministry of Defence brownfield land. Our big difficulty though is that all of the numerical techniques are based on money. And money as a measure, particularly over any appreciable time period, is very problematic.



Our firm’s work at the junction between technology and finance has been inspired by Danny Hillis’s Long Now question, “how could one build a clock to last 10,000 years” ticking once a year, bonging once a century, with a cuckoo squawking once every millennium. Over the years our ignorance about economics, finance, and money grew so much that in 2005 we launched our own Long Finance initiative asking “when would we know our financial system is working?” Could we build a financial system that might last a century? A decade and several economic crises later we have some ideas, and a few possible solutions, but lots more ignorance to share.



About LONG FINANCE

‘When would we know our financial system is working?’

Objectives:

- ◆ Expand Frontiers
- ◆ Change Systems
- ◆ Deliver Services
- ◆ Build Communities

 London Accord
  Financial Centre Futures
  Meta-Commerce
  Eternal Coin








It's popular, and easy, and slightly unfair to criticise the economics that accompanied the financial crises. The caricature economist postulates a rational, emotionless, human-being making decisions under conditions of perfect information in competitive markets. Economists themselves have criticised this simple model for decades and have explored all sorts of variants from the non-rational human-beings of behavioural economics and Prospect Theory to different supply and demand curves for positional goods, tournaments, or networks. Economists range across the visible hands of planning, the invisible hands of markets, the translucent hands of decision makers, the helping hands of volunteers, and the grabbing hands of governments.

So how ignorant are we in economics? Quite.

1 – we can't explain boom and bust. We still argue about the Great Depression and grudgingly concede World War II may have been the economic solution. We don't understand the hundreds of adjustments to dubious collection procedures that make up GDP. We adjust GDP by several percentage points for the informal economy but then celebrate or bemoan quarterly decimal point changes. 25% to 40% of global trade is non-monetary, so we don't analyse it. We don't know at what level of national debt an economy collapses. The world's second largest economy, Japan, has taken solid doses over decades from every macroeconomic school's medicine cabinet to no avail. Despite Japan's numerical economic disaster, living standards are not falling through the floor.

2 – why do we still have poverty in a world where overall production is sufficient? If distribution is the problem, why can't markets fix this? Since 2003 we've been unable to answer this crucial question about Iraq - "how can the world's largest economy restart a medium-sized economy in the Middle East about the size of California?"

3 – we can't fix our environmental externalities. Politicians believe economics is wrong and Germany's Energiewende or the UK's nuclear extravagances are right. Jeffrey Sachs points to the discount rate "tyranny of the present over the future" - "If the value of the resource is likely to grow more slowly than the market rate of interest, the blaring market signal is to deplete the resource now and pocket the money! ... As expected from the theory, slower-growing animals and plants are especially endangered today." [Sachs, 2008, page 40] Activities which diminish the effectiveness of saving increase the discount rate, thus making us more short-term.

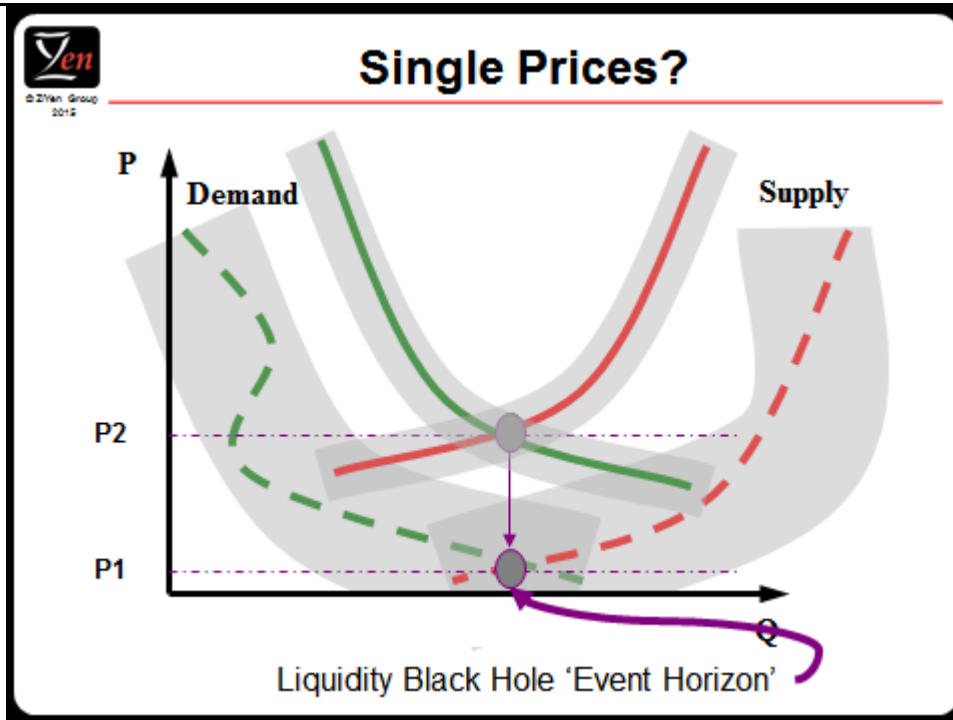
Finance seems easier to analyse than economics. Lots of hard-looking numbers, lot of interesting regulatory loopholes, lots of seductive theories. Come to the City of London Laboratory to play with financial figures in the world's leading international financial centre.

The divide between the financial industry and financial academia is large, perhaps larger than any other trade-teaching divide. Financial theory is a mess of gimmicks rather than a coherent field. Finance departments set a prospective doctorate a thesis somewhere between the hard and soft efficient markets hypothesis. The student is told to find a dataset with some prices to test the theory. The student is never told that specific prices are abstract ideas. The student tortures the data set producing a result somewhere between hard and soft. The student is then awarded a doctorate in finance despite learning nothing about real prices, though along the way learning much about time-series analysis and statistics.



Yet finance is attractive to quantitative folks who like numbers. But the caricature quant studied systems with strong, negative feedback. Otherwise earthquakes, volcanoes, or storms would tear the world apart. Their biggest mistake is to believe that money is a physical measure of enduring value.


Once upon a time there was a man who ran the finest fish and chip shop in the whole of the country. People came from miles around to get tasty fish that was freely covered in thick egg-batter including his secret ingredient (beer) and thick-cut chips with plentiful sauces. The man was so successful that he could afford to send his son to Harvard. After graduation, the son came back to work with his dad. “Dad”, he said, “based on the current economic statistics, we’re heading for a recession. You’ve got to stop using all that thick batter, and you dish out ketchup as if it was free.” The father was torn. He’d always been generous to his customers, but his very bright boy didn’t get all that education for nothing. So, reluctantly, dad cut back on the egg-batter and the sauces. His son even convinced him to leave that pricy beer out of the batter. It was just in time though, because it turned out his son was right – dad’s business took a real dive.



Finance's fundamental assumption is a recursion that what people believe that other people believe what other people believe, ad infinitum, determines value. When fashion people tell you that "black is this year's new black", realize that they are trying to create momentum towards buying their large stocks of dark materials. Human value systems exhibit strong feed-forward, or positive feedback in the jargon. Of course such strong kurtosis means non-normal distributions. Yet most natural scientists assume normal distributions in finance to make their work easier; in other words they go off to study the Wizard of Oz, not the real world.

So how ignorant are we in finance? Quite.

1 – price is not a single number. The idealised supply and demand curve is really a cloud of potential matched-pairs, with holes in the cloud where you can't trade ("I really must sell 47,777 units but they only permit blocks of 10,000 units"), and horribly complicated by embedded time in contracts. Commodity pricing differs enormously from financial instrument pricing because of delivery cost and risk. Market values for companies differ markedly from book values. If two companies merge or acquire the price is never $A+B$, rather it's much higher or lower. Yet we still calculate market capitalisation by multiplying the number of shares by the marginal price of the last-traded share. We confuse the monetary value of a spot transaction with value at scale over time. A multi-year contract has no specific price or value.




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Lunacy, Heresy, Or Orthodoxy?

Measurement	<ul style="list-style-type: none"> Confidence Accounting™ Long Term Performance Measurement Uses and Abuses of Discount Rates*
Financial System	<ul style="list-style-type: none"> Insured Utility Banking* Futures of Finance Clustering* Asset Management* Global Financial Centers™ Emerging Markets* Self-Data Research
Monetary Systems	<ul style="list-style-type: none"> Common "Yenders" Global Coin* Cryptocurrencies (aka Alt Coins) and Blockchain*
Regulation	<ul style="list-style-type: none"> Hotspots* Industry Standards Markets* Compliance Architecture
Governance	<ul style="list-style-type: none"> Ethics Ethical Banking*
Structure	<ul style="list-style-type: none"> Pensions Solvency Assurance and Internal Growth Rate Measures for Pensions** Cyber Resilience*
Behaviour	<ul style="list-style-type: none"> Concepts of "Fairness"
Sustainability	<ul style="list-style-type: none"> London Accord 2017** (24 Integrated reports) & London Accord* Burn it all? Policy Performance Bonds (Index Linked Carbon Bonds & Index Linked Forestry Bonds)*


* Indicates research at an active stage ** Indicates research at an advanced stage



"Get a detailed grip on the big picture."
Chao Kli Ning

2 – stranded assets. In 2006 Long Finance asked how much CO₂ ppm equivalent do you add to the atmosphere when you use all of the fossil fuels on balance sheets. Our figures exceeded 1200ppm without shale gas or tar sands when you burn-it-all. Others such as Carbon Tracker publicised this a few years ago. Markets may be resolving this paradox now in the near-term price of fossil fuels, but how was it overlooked for decades? The music industry is shrinking yet we have more music than ever.

3 – why are bubbles and scandals big surprises? History is replete with bubbles and scandals presided over by auditors and regulators, from bubbles and scandals of the 16th century to Enron or RBS or Tesco today.

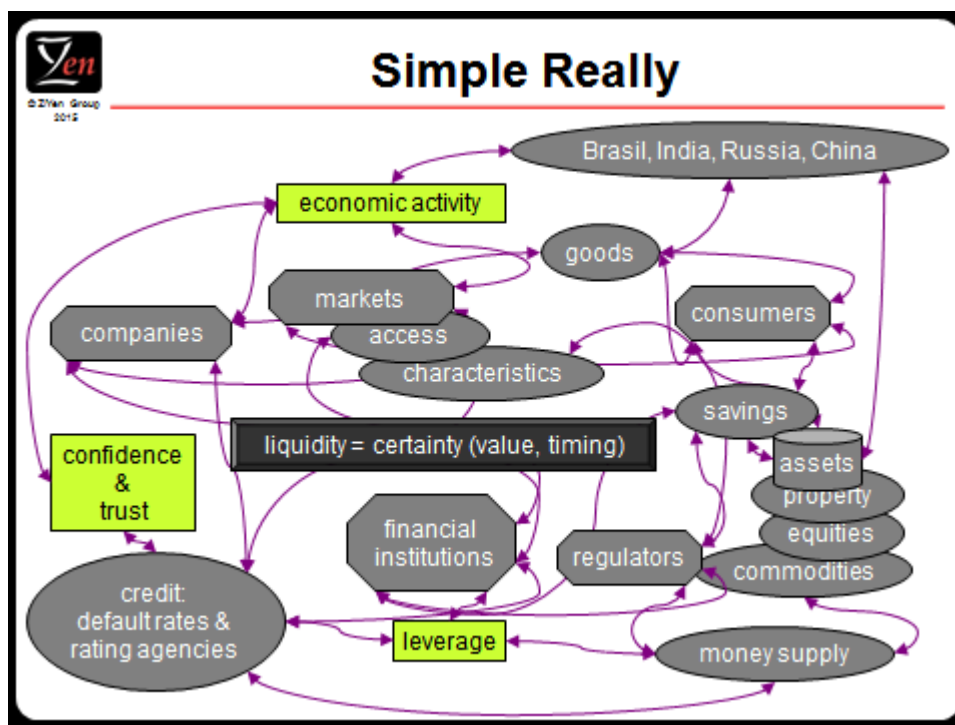


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Confidence Accounting

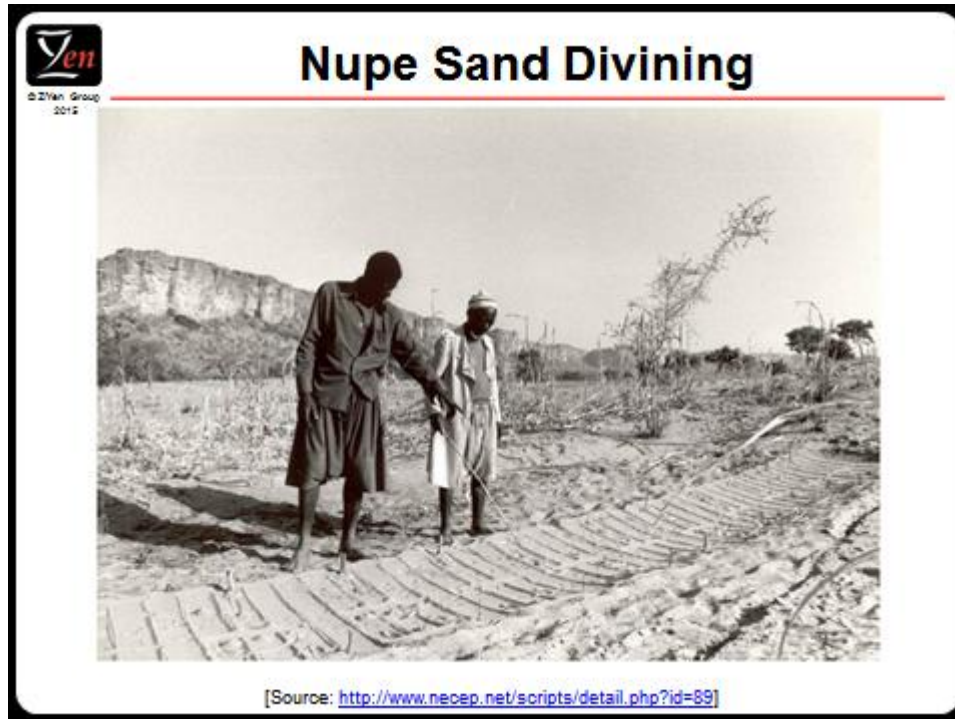
Balance Sheet as at 30		in millions					
		Nominal	Expected loss	Estimated value			
Assets							
Loans and advances - banks		80,000,000	55-04	25,000	49,500,000		
Loans and advances - corporate customers		100,000,000	0-007	700,000	99,300,000		
Loans and advances - retail customers		200,000,000	0-011	3,000,000	197,000,000		
Debt securities							
	Level 1 and 2	60,000,000	0-002	120,000	59,880,000		
	Level 3	10,000,000	0-002	20,000	9,980,000		
Derivatives							
	Level 1 and 2	150,000,000	36-04	45,000	149,955,000		
	Level 3	20,000,000	55-04	5,000	9,995,000		
Other		120,000,000			120,000,000		
Total		700,000,000		3,915,000	696,085,000		
Liabilities							
Deposits		350,000,000			350,000,000		
Debt securities		75,000,000			75,000,000		
Derivatives		150,000,000			150,000,000		
Other (accruals, tax, short positions)		25,000,000			25,000,000		
Subordinated debt		60,000,000			60,000,000		
Total liabilities		660,000,000			660,000,000		
Equity							
		40,000,000			40,000,000		
Total		700,000,000			696,085,000		

Long Finance doesn't just criticise. For example, we propose Confidence Accounting, using distributions rather than discrete values in accounting, a shift to interval estimates and confidence levels. In a world of Confidence Accounting, results of audits would be presentations of distributions for major entries in the profit and loss, balance sheet and cashflow statements. The value of patents might be stated as an interval, £100,000,000 ± 95,000,000, recognising a wide range of interesting technologies and their inherent uncertainties. Next to each value would be the confidence level that another audit would produce a value within that range. Finally, there would be a picture to show the shape of things. Benefits of Confidence Accounting include a fairer representation of results, reduced footnotes, measurable audit quality and a mitigation of mark-to-market fluctuations. Confidence Accounting has gained the support of the Association of Chartered Certified Accountants, the Chartered Institute for Securities & Investment, and leading thinkers from the Bank of England's Andy Haldane to Sir David Tweedie of the International Accounting Standards Board.



The great test of any body of knowledge is predictive capacity. It's rather simple for a chief economist. (1) Consumers want goods and (2) companies want to provide them for profit, which (3) creates economic activity. To expand, (4) companies go to financial institutions which must (5) evaluate their credit. Meanwhile, (6) consumers are starting to save and (7) build up assets. These savings (8) go to financial institutions, thus completing the core funding circle. But this funding circle can be enhanced if (9) financial institutions tap into markets. (10) Companies too, with appropriate credit assurances, (11) tap into markets. The core money supply has always been regulated, but now, for the sake of the consumers, regulators watch (12) savings and (13) financial institutions with a new awareness that (14), the money supply is not just cash and (15) is increasing with ease of credit, so (16) financial institutions and their leverage are core to the system. Leverage in turn affects (17) credit and (18) the money supply. Of course, with this much money sloshing around, people can afford to (19) bid up asset prices and, given the increased value of their assets, (20) not save so much and perhaps even (21) play the markets themselves. This makes them (22) more

aware of economic activity and (23) brings out the regulators to watch over them. Now thoroughly flush, (24) consumers are more desirous of goods, (25) importing them and (26) increasing economic activity, while (27) exporting countries build up assets and the money supply. All of this economic activity (28) depends on confidence & trust, which in turn builds up (29) credit that finds its way to (30) inflating markets. Naturally all of this trust & confidence are pinned on (31) liquidity. Until it collapses.



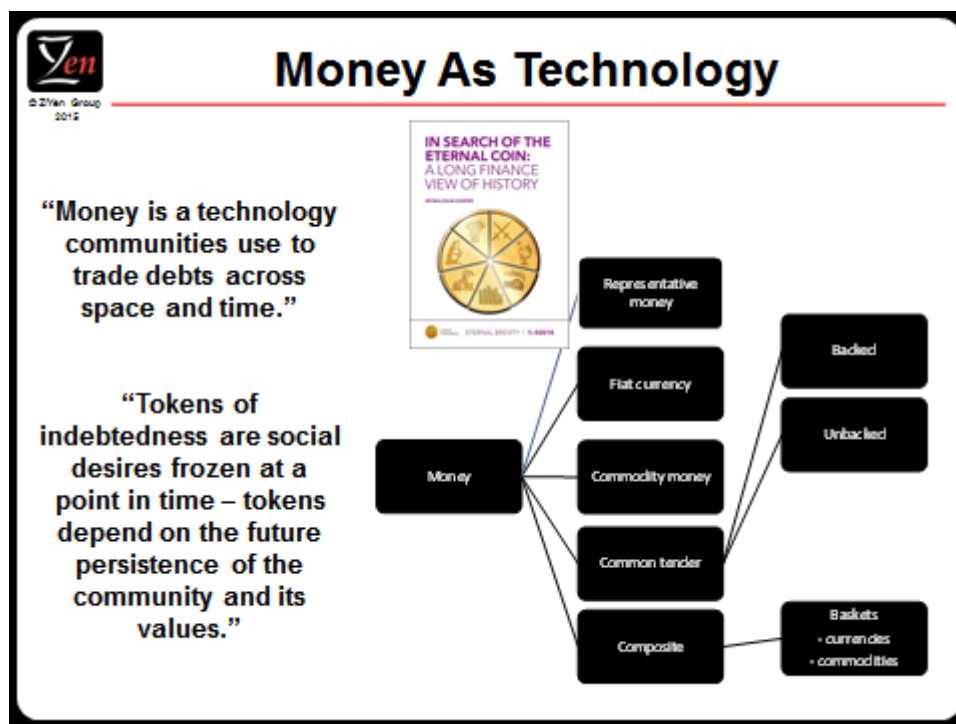
A currency trader lives and dies on results. The guys and girls on the currency trading floors recognise that their firm's chief economists are talking heads with prestigious degrees and nice accents for marketing the firm on television. As we've just seen with the Swiss Franc, chief economists can't predict currency movements. Whether it's economic figures, interest rates, share prices, productivity, or inequality, our top economists are beaten by monkeys, real monkeys. Burton Malkiel in 1973 said "A blindfolded monkey throwing darts at a newspaper's financial pages could select a portfolio that would do just as well as one carefully selected by experts". The Wall Street Journal proved him right. An interesting new paper demonstrates the self-belief of economists in their superiority despite contrary evidence, yet also that the public believes in them almost as much as they believe in themselves.² Naturally, self-confident chief economists don't ask currency traders to which school of macro or micro economics they subscribe, probably because they'd have their trousers pulled down.

Prognostication, prophecy, and strategic planning help people address their fear of the future. The Nupe are a people in West Africa who have developed a very sophisticated system of prophecy based on patterns in sand. As one anthropologist studying Nupe prognostication in 1954 noted:

² Fourcade, M., Ollion, E., & Algan, Y. (2014). The Superiority of Economists. *MaxPo Discussion Paper*, (14/3) - http://pubman.mpg.de/pubman/item/escidoc:2071743:2/component/escidoc:2071741/mpifg_mdp14_3.pdf

“The most striking feature of Nupe sand divining is the contrast between its pretentious theoretical framework and its primitive and slipshod application in practice.” [Nader, S.F., *Nupe Religion*, 1954, page 63 from Feyerabend, 1988, page 50]

Human intelligence injects uncertainty into social systems. Intelligence gives social systems the ability to predict their own behaviour, but prediction is often wrong and leads to perverse consequences. Fantasy writer Jasper Fforde’s postulated a “[Human Expectation Influenced Probability Theory](#)”. Nupe sand diviners and astrologers exist to keep economists company.



Long Finance circles a major problem; we have no theory of value. Economists have been creating value since the days of Smith, Ricardo, and Marx. We have labour theories of value, production theories, utility theories, power theories. So how can we calculate and communicate value? We rely on money. But does measuring money really equal measuring value? Robert Mundell, accepting the 1999 Nobel prize - ‘The main thing we miss today is universal money, a standard of value, the link between the past and the future and the cement linking remote parts of the human race to one another...’ In fact it’s so bad that money and finance are typically exogenous to mainstream economic theories. Paradoxically economic theories evaluate themselves using money as a measure.

Anthropologists evaluate money as a community technology akin to music or telephones. Scientists have found that while primates may not create monetary systems, they understand money. Capuchin and tamarin monkeys at Yale grasped the idea of tokens so well that they stopped saving, started raiding, gambling, and prostituting themselves. An old economics rhyme for money is “Money is a matter of functions four, a medium, a measure, a standard, a store.” It is difficult to think of any form of money that has delivered all four matters, “medium, measure, standard, store”, for a significant period of time. To be a medium of exchange brings trade into conflict with storage. To be a standard unit of account means keeping relative value to a basket of needs, but those needs change with technology,

scarcity, or fashion. To be a store of value means the community values must persist, the community itself must persist and honour its debts, and some people must be willing to defer gratification, perhaps despite inflation. Bitcoin has been a poor unit of account in its short lifetime, a growing medium of exchange, and a poor store of value, so far.

My definition of money is “a technology communities use to trade debts across space and time” – typically a self-referential token-based system. These tokens of indebtedness are social desires and values frozen at a point in time. The tokens depend on the future persistence of the community and its values.


Fiat, ‘let there be’, currency, the dominant form of money today, is an artefact created by governments. Fiat currency consists of tokens that allow us to extinguish tax debts. We trade those tokens freely in a geographic region where we are likely to meet people under the same tax system. Fiat currency’s value lies in its ability to cancel tax debts. Governments ‘back’ their currencies through their monopoly on the use of force, creating a semi-coerced community of taxpayers. Governments create and destroy fiat currencies at will through borrowing and taxation – budgets are chess games where governments can buy more pieces when they lose. By managing the level of tax debts in the economy, both up and down, governments supposedly create credit that facilitates trade and exchange. Fiat currency is a good medium for near-term exchange within a tax zone, but has traditionally been a variable unit of account that leaks value. Here’s a question, assume an inefficient government doubles its tax take from 20% of GDP to 40%. Assuming no printing of fiat currency and that the government can enforce its tax rates, what happens to the supply and demand curve for its currency? Currency value rises even though the economy may be impaired. This is a core problem. Why should politically issued tax credits equate to the need for trade and exchange? Clearly there is a loose relationship but this is fundamental methodological problem at the heart of macro-economics should terrify anyone using fiat currency to measure value over more than a few years.

To paraphrase John von Neumann on the use of pseudo-random numbers, anyone who considers contrasting the price of a paper clip with the price of an aircraft carrier or a hospital is living in a state of sin. Just for starters, such half-century comparisons using ‘our measure, our standard’ of fiat currency bring into the analysis decades of national debt politics, oligopolistic market structures, and imaginary management accounting rules.



So how ignorant are we about money? Quite.

1 – Kay Ingram said, “Women prefer men who have something tender about them - especially legal tender”. So is a man who has all the money in the world the most attractive? Clearly not, because if you have all the money in the world it has no value. You can see value increase with distribution, two people splitting the money, three, etc. The Thomas Piketty-inspired debate about inequality piques my interest in a set of differential calculations on distribution and monetary value taking into account future population, wealth distribution, tax credit needs, national debt, demurrage, and the strength of the monopoly on the use of force.



Ignorance About Money

- ◆ What is the value of money if one person holds all the cash?
- ◆ What happens if you call your tax authority and tell them you just don't feel part of the community but will call when you're back in the mood?
- ◆ What is the value of £1 in France versus a pound in the Shetlands?
- ◆ Why can't you go to your central bank and ask for a 'bucket' of GDP?
- ◆ What happens to the value of a government's money during a civil war?
- ◆ If your nation won the 'put your feet up for a century' lottery – in what currency would you take your winnings?
- ◆ Is the Euro a tax scrip?

2 – if you don't believe pounds are enforceable tax credits call HMRC and explain that you're not feeling British this year but will give them a buzz when you do. See what new community you join.


3 – why can I go to 600 miles to the Shetlands and use pounds but 90 miles to Calais and have to exchange them? Because the French are under a different tax system.

4 – why can't you convert your money into GDP?

5 – if every country on earth was prepared to give the UK 100 years of cash, in what currency should we take it?

6 – why does government currency in a war zone lose so much value? Because people wonder if the government and its tax system will persist in its present form.





7 – speaking of war zones, why is the Euro zone having monetary difficulties? Because the tax basis of fiat currency is not reflected in the construction of the Euro.




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2015

Evolution In Time & Space

- ◆ Money 0.0 – communal village
- ◆ Money 1.0 – social tokens
- ◆ Money 2.0 – traded value, Mesopotamia
- ◆ Money 3.0 – gold & silver 1.0, Lydia
- ◆ Money 4.0 – bills of exchange, Northern Italy
- ◆ Money 5.0 – fractional reserve goldsmiths
- ◆ Money 6.0 – central banking 1.0 – cheques, 17th century
- ◆ Money 6.5 – gold & silver 2.0, 19th & early 20th century
- ◆ Money 6.0 – Richard Nixon & ultra-leverage
- ◆ Money 7.0 – ?




Moreover, moving beyond the tax scrip definition of fiat currency, in our current monetary system, fractional reserve banking, we give banks an oligopoly to multiply the amount of currency in circulation. Another term for this is leverage. Leverage permits banks to lend a multiple of what they have on deposit. Other firms can leverage to a small degree, but banks are permitted to do so at levels where any other firm would be considered insolvent. Banks such as RBS had leverage ratios of around 50:1 when the crises began. The permitted maximum is now 33:1. Overall levels are around 15:1. Historical convention is about 10:1. The New Economics Foundation points out that around 97% of money currently in circulation in the UK is actually created by commercial banks. With such swinging multiplication of tax scrip, leaving aside deposits into banks of leverage money that in turn create opportunities for leverage, we really don't know how much money there is in circulation, by a seriously wide margin. Warren Buffett smirks too, "When you combine ignorance and leverage, you get some pretty interesting results."



The Long-Term?

Theme	Service	Question
Trust	Identities	communities
Space	Transactions	services
Time	Debts	value-added




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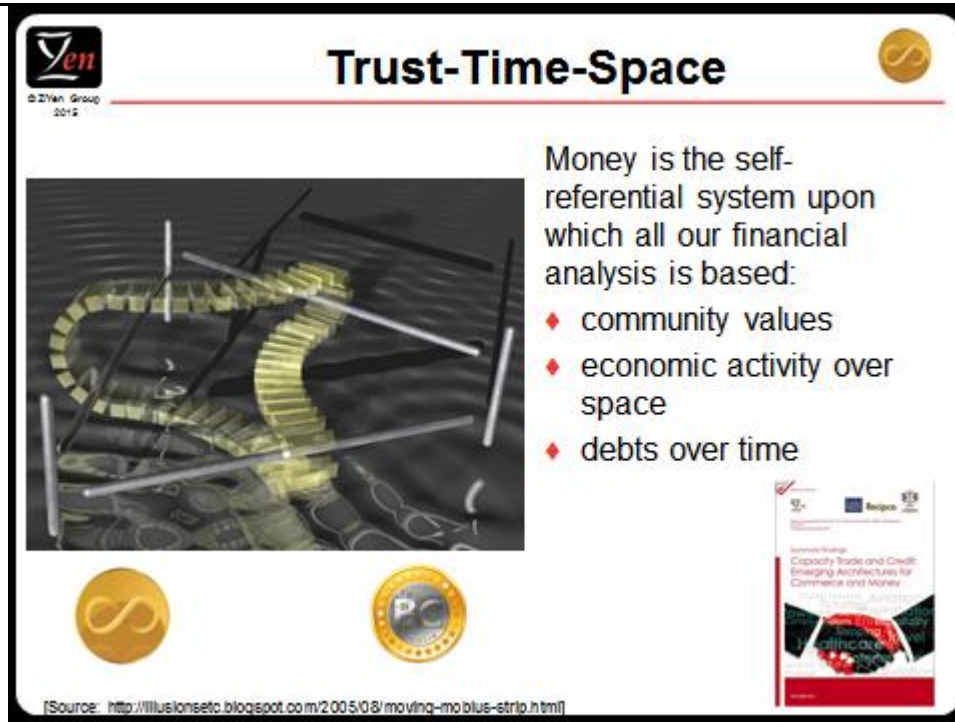
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We often fail to recognise that monetary technology evolves, introducing yet more uncertainty. The major changes are every generation or two, the Federal Reserve of 1913, Bretton Woods, perhaps the last one being that great economist, Richard Nixon, dropping the gold standard in 1972. 600 AltCoins have emerged since 2009, with Bitcoin the most prominent. As people use AltCoin technology more, they will question traditional fiat currency more, and in turn the role of governments and taxation in money and value.

After all these uncertainties, I hope that you recognise that we have no theory of value and that you cannot use pounds, euros, or dollars in equations with confidence over large areas or long time periods. Despite their deceptive resemblance to physical measures, you can't use financial numbers without a deep understanding of the community upon which the money is based.



The slide features the Z/Yen Group logo in the top left and a gold infinity symbol in the top right. The title "Trust-Time-Space" is centered at the top. Below the title is a 3D illustration of a yellow infinity symbol on a dark, reflective surface with several vertical poles. To the right of the illustration is a bulleted list: "Money is the self-referential system upon which all our financial analysis is based:" followed by three items: "community values", "economic activity over space", and "debts over time". At the bottom left are two gold coins, one with an infinity symbol and one with "PC". At the bottom right is a book cover titled "Innovation, Capacity Trade and Credit: Emerging Architectures for Commerce and Money". A source URL is at the bottom left: "[Source: http://illusionsetc.blogspot.com/2005/08/moving-mobius-strip.html]".

Before I close, I'll paraphrase a Conservative Party slogan from the last election for my definition of Knightian ignorance, "you're not thinking what I'm not thinking". Analytical techniques are there to make us feel good about decisions on the future. All of the analytical techniques will vary and conflict. Voltaire said, "Doubt is not an agreeable condition, but certainty is absurd." Just because a technique is numerical gives it no particular advantage. Nobody has an answer to how do you choose how to choose the right analytical technique, let alone decide when none will do. You need courage to justify decisions on a variety of techniques and the balance of probabilities on gut feel. After all, what is our first major choice in life? Whether or not we believe in free will.

Today I want you to take away one definition, one quote, and one observation, along with a whole lot of ignorance. The definition I gave you earlier – "money is a technology communities use to trade debts across space and time".

The quote to remember when analysing money is from journalist Simon Carr, "Money turns out to be whatever we agree it to be. It is a collective work of the imagination." [Independent (12 January 2009)]

The observation for all, but especially the civil servants here, is that HM Treasury, the Ministry of Defence, HM Revenue & Customs, and the Home Office are symbiotic on the taxpayer. HM Treasury values defence, tax inspectors, and courts because they heighten faith in the persistence of the tax system and thus the currency.

If love of money is the root of all evil, then the study of money must be the source of much madness. While, I come to the end of this talk leaving you with much less uncertainty about my chances of a tenured position in a traditional economics or finance department, I do hope I've shown you where you should be ignorant about money. Our Long Finance koan goes, "If you have trust I shall give you trust; if you have no trust I shall take it away". After all, that's the key thing about uncertainty; you need to be certain about where to be uncertain.



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When Would We Know Our Commerce Is Working?



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THANK YOU!

Thanks

Without implicating them in any way and not wanting to dent their track to a tenured post in economics or finance, I would like to thank Dave Birch, Nick Goddard, Stephen Martin, and Jan-Peter Onstwedder for some uncertainty-heightening conversations that helped me with this talk.