22nd Bank Indonesia Institute Open Lecture Series

Financial Innovation in the Digital Age:
Challenges for Financial System and Monetary Stability
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Introduction by Arlyana Abubakar, *Bank Indonesia Institute*

Welcome to Bank Indonesia Institute. It is a great pleasure and an honour for me to welcome all of you on the 22nd Open Lecture Series with the current topic, "**Financial Innovation in the Digital Age: Challenges for Financial System and Monetary Stability**".

The Open Lecture Series is one of BI Institute's learning programs which aims to update recent developments in economic, monetary, financial and payment system issues. The Open Lecture Series was established for the advancement of the knowledge of Bank Indonesia policymakers as well as to widen and sharpen the perspective of Bank Indonesia's stakeholders, such as government agencies, academicians and professionals.

These events are an integrated part of our partnership programs, co-hosted with various leading institutions. This is part of the Bank Indonesia Institute's journey towards being a world-class learning institution.

Massive adoption of digital technologies is radically transforming the world. Mobile phones and the internet, together with exponential growth in computation and storage capacity at a lower cost, have changed the way of business.

The development of payment networks for e-commerce marketplaces, mobile banking for the unbanked and big data for data analytics have increased efficiency.

For instance, a growing number of consumers are using services such as GoPay via their smartphone, telecommunication companies including Telkomsel have begun offering payment services through their mobile platform, and banks have started to offer e-wallets, allowing customers to carry out transfers, payment and withdrawals without having a bank account. Furthermore, internet-based peer-to-peer lending and crowdfunding platforms have spread and are projected to grow in the coming years.

Nevertheless, central bank and government institutions should also be aware of the challenges emerging due to digitalization. Interconnection, third-party reliance, data sharing and cybercrime have increased operational risk and systemic risk in the financial system. Meanwhile, unrecorded online transactions could understate economic growth.

Therefore, the need for well-defined policies among policymakers on the control and management of new technological risks will be essential, so the economy may operate close to its full potential.

According to this issue, Bank Indonesia issued a regulation on financial technology in 2017 to encourage innovation and support the establishment of a financial technology ecosystem by

[1] This is essentially a transcript of a lecture given by Andrew Sheng, edited to clarify certain parts. The author is grateful to Bank Indonesia Institute for support and assistance. All errors and opinions are person to the author.

observing the principles of consumer protection, risk management and prudence. In the regulation, financial technology operators in the payment system must register with Bank Indonesia and they are obliged to submit information to Bank Indonesia on new products, services, technology, and/or business models that meet the financial technology criteria. Through the regulation, Bank Indonesia expects to foster a sound financial technology ecosystem that may consistently support sustainable and inclusive national economic growth by maintaining financial system and monetary stability.

Every decision that public and private stakeholders make must be approached with a great sense of responsibility. Moreover, collaboration and sharing among all stakeholders are vital to ensure that digitalization benefits the economy, while preserving financial system and monetary stability.

Here, the 22nd BI Open Lecture Series has succeeded in presenting Dr. Andrew Sheng with expertise and experience on the issue of financial innovation challenges. We expect this open lecture to enhance our understanding on the potential benefits of financial innovation in the digital age, the challenges that regulators may pose and expected responses of policymakers.

Keynote speech by Andrew Sheng, Honorary Board of the BI Institute

Ibu Ariana said that the objective of the BI Institute is to help you and Bank Indonesia to become the best emerging market central bank. If you want to be the best, you have to think very differently. The purpose of this lecture today is not to give details about the digital age: it is to tell you how to think very differently about the digital age because if you think exactly how Google and Facebook want you to think, you are a follower. To be the best, you must be a leader. How to be a leader? How to think very differently? That is the purpose of this lecture.

I am very honoured to be invited to give the Bank Indonesia Institute 22nd Open Lecture Series. Ibu Arianna mentioned that to be the best, to be a leader, you must have responsibility, you must have integrity. Bank Indonesia is in charge of system stability: monetary stability and financial stability. To be in charge of that stability, you must be able to think, you must be able to act and you must do it with professionalism. Leadership is a combination of responsibility, integrity and professionalism. If you are not professional, you cannot be responsible. You have to be professional.

What I am trying to teach you today is to think through the whole idea of what the digital age is. Why is it the digital age? How do you work in the digital age? For whom do you work in the digital age? Every time you meet a question, you step back and think: what am I doing? What business model am I in? Why am I doing this? How can I do this? And for whom am I doing this? If you are doing it for yourself, you are not a leader. You are doing this for the people. Therefore, you must think for the people. That is the purpose of a central banker. All my life, this is what I have been trained to do by my mentors, including the first Malaysian governor of Bank Negara Malaysia – Tun Ismail Mohamed Ali - namely integrity, professionalism and responsibility. We are basically in the same boat.

Understand the Context

We are all boiling - this is the hottest year in recorded history. The image of humanity in this age of climate warming is one of the frog in the pot. If the water is boiled very slowly, the frog will not jump out because it is still very comfortable. If you boil the water very quickly, however, the frog will jump out. We are in an age in which human beings are boiling mother Earth through excessive human activity through consumption and production that produces carbon emission. If we do not act, we will all be boiled.

Was this taught in economics? No! Did Adam Smith (Wealth of Nations, 1776) mention the word weather or climate change? No! Did John Maynard Keynes (General Theory of Money, 1936) mention climate change or inequality? No! Did Milton Friedman (Capitalism and Freedom, 1962) even talk about climate change or technology? No! All the mainstream economic thinking since the Second World War was about the free market. A free market for everyone or the West? If you want to think about all this, you have to understand what economics is and who is it for. We have now entered into the biggest crisis of climate change and inequality. Because of inequality, there are huge political backlashes, such as populism and we have forgotten that economics is about the political economy, not just economic theory.

Today, we are moving into the digital era. What is the digital era and what does it mean? That is the purpose of this lecture. I want first to talk about the big picture. Gerry Corrigan was the President of the New York Fed and a disciple of Paul Volcker. I consider Paul Volcker one of the best central bankers alive today. Gerry Corrigan went and worked for Goldman Sachs, which is another story, but Gerry Corrigan taught me one thing that I thought was very useful, namely, that whenever you look at a problem, go up to 30,000 feet above the earth and look down. Then you will see a very different picture of a blue planet with oceans, lands and clouds. After that you can slowly move down. At 3,000 feet, you no longer see the ocean, all you can see in Indonesia, is Java, maybe Jakarta. If you descend all the way to ground level, all I can see is this room. At 30,000 feet, I have the macro picture and at ground level, I have the micro picture, but what happens in the middle? What happens between the *macro* big picture, and the *micro* activity which economics studies? Where are the institutions, such as Bank Indonesia, Ministry of Finance and the banks? When you implement policy from 30,000 feet up, you implement policies not directly to the people, you implement through institutional channels. You have macro and micro-economics, but you must also include the *meso*-economics of the middle, which are human institutions. When you undertake monetary policy, you influence the banks and the banks impact the people because the banks either lend, borrow or take deposits. The institutions are the channels between the macro and the micro.

First, I would like to talk about the big picture of what digitization is all about. Then I would like to talk about why we did not see what we did not see, such as why we missed the economic, political and ecological crises of our time. Finally I will discuss how we manage stability at the systemic level.

What is the big picture? The reason why the new economic free-market ideology missed seeing the 2007 global financial crises and its political and planetary consequences was due to what I call 6G mega-trends. The first G stands for Geopolitical, which is the shift from a unipolar to multipolar world as other nations catch up to the United States. The second G stands for Geographical. Most Western people think that everything up until now has been Eurocentric, but actually before the 1800s, Asia (India, China, ASEAN and the Middle East) accounted for half of world GDP. By around 1920, however, Asia contributed only 15% of GDP. In just 120 years, Asia declined from 50% of GDP to just 15%, mostly due to exploitation precipitated by colonialism. Colonisation took India's share of world GDP from 24% down to 4%[2] by 1950. Great Britain became rich due to colonising India and Africa and used these resources to shift to industrialization. Holland became very rich because of Indonesia. America became very rich because of the massive landmass that was taken from native Indians. Colonialization actually changed the global landscape because the West used global resources to advance to the industrial society. Of course, they used science, technology, governance and markets to help them dominate the world.

[2] Utsa Patnaik and Prabhat Patnaik (2016), *A Theory of Imperialism*, Columbia University Press

But today Asia is again one half of mankind: income in Asia is beginning to catch up and somewhere between 2030-2040, Asia will again account for one half of global GDP. Just think about the why. This is because Indonesia, which is the fifth largest country in the world, growing at +5%, Vietnam, with a population of 100 million, is growing at 6.7%, India last year was growing at 7%, China is growing at 6% per annum. In other words, ASEAN is growing at more than 5%, India is growing at 7%, China is growing at 6% and the three together add up to more or less half of world GDP. You have half of the global population growing at 5%-6%, with Europe barely managing to achieve 1% or 2%. America is doing well growing at 2% per annum. Clearly, sometime by 2040, Asia will go back to accounting for its fair share of global growth. That is an enormous achievement in terms of the geographical shift represented by the second G.

Next is the Gender shift. The easiest way to think about the gender shift is to look at women's income now, which is around half to maybe 60% of the men. World income and wealth would grow if there is more gender equality. Using just one simple example in China, where each family has one child, so half chance of either boys or girls. Next generation, therefore, who is going to inherit the wealth? The family. Therefore, half of the wealth of China will now belong to women. A very different situation will emerge because men like to fight and women like stability. I am serious. You have to understand how the change in gender wealth alone will change things.

The fourth G is Generational. There are 900 million rich people in the world, consisting of 500 million in Europe, 300 million in America and 100 million in Japan. This is all old money and getting older. The average age of a Japanese farmer is 70 years old. In 10-15 years, there will be one worker for one retiree, as opposed to the current situation of two workers for one retiree. 20 years ago, there were four Japanese workers for each retiree. How can anyone be productive when there is one worker supporting one retiree? We will all be too busy looking after our pensioners. Therefore, this generational shift is also very problematic for an aging society. But throughout the Middle East, throughout Indonesia, India, Latin America and Africa there are many young people with no jobs; young people coming up with no jobs. No jobs mean instability. The generational shift also has very serious consequences on our behavioural patterns.

The fifth G is Geo-climate change. We are now facing everyday major heating of the climate that is changing with tsunamis, tornadoes, forest fires and so on. We are seeing temperatures that we had never dreamt of. When the ocean warms up, the glaciers disappear. Just think about the Himalaya ice cap. Why are the Himalayas so geopolitically important? The ice cap in the Himalayas feed the Indus river in Pakistan and India; the Irrawaddy river in Myanmar, the Mekong river for the whole of mainland Southeast Asia and the Yangtze/Yellow Rivers that waters the whole of China. If the Himalayan glaciers were to disappear, every time it rained, flash floods would decimate the region. In India, 70% of water for agriculture today is from the well, which is going down approximately 5-10 metres every year. If the wells are getting deeper, water becomes polluted and there is no water in the river, how are we going to eat? There will be a food and water crisis. Climate change is existential.

Finally, the sixth G is 5G technology – the digitization of the economy. The UNCTAD Digital Economy Report 2019 sums it up well:

"Data flows grew from about 100 gigabytes (GB) per day in 1992 to more than 45,000 GB per second in 2017. And yet the world is only in the early days of the data-driven economy; by 2022 global IP traffic is projected to reach 150,700 GB per second, fuelled by more and more people coming online for the first time and by the expansion of the Internet of Things (IoT)."

One phone to win them all. You are no longer the master but a servant to your phone. My wife does not know where I am but Google does. Do not think that by switching off your phone, Google will not know where you are.

To sum up, just one of these six mega-trends would be problematic, but all six are inter-acting at the same time. That is why it is so difficult to understand what is going on. The reality that you must understand is this: global warming will create more and more losses. We all talk about growth yet every time there is a tsunami or a lack of drinking water, big problems emerge. In Indonesia, you must no longer think like Americans: we cannot afford to live like Americans because if the average Asian consumed energy and emitted carbon like an American, the world would end. We do not have enough natural resources to consume at the rate Americans are consuming. This is an existential question that we must think through. Even if everybody agrees that climate change is a big problem, we cannot act because we do not agree. President Trump has even denied that there is a climate change problem, so we have to think very seriously how we can collectively work out a solution to prevent a planetary crisis.

Many of us are familiar with the Branko elephant curve[3]; the 1% of world population over the past 40 years has captured 27% of the growth in income. The world is very unequal. It is very unequal because the free market says that I am free to get rich and you are free to get poor. That is not fair and when circumstances are not fair, people start protesting. Unfortunately, protesting does not solve problems, so the key question is what we are going to do about inequality and climate warming?

We are on the SS Planet Titanic, which means we are heading for disaster but the statistics do not show it. The statistics not show it because GDP is an average. You and I are trained to think in terms of averages. Average GDP growth is 5%, yet rich people are gaining 30% more than the 5% and the poor people are getting 30% less than everybody else, and many may be getting negative income – falling further into debt and poverty. Consequently, income disparity is becoming wider and wider, which cannot be sustained. It is very important that we do not think in terms of averages. People do not drown in three inches of water, except they forget there is a sinkhole and you can fall in and drown. On average, everything appears okay. The average between one billionaire and 1,000 people who have less than poverty level income, the average income still looks okay. Therefore, average is the wrong description of reality. The same is true with climate – the average danger range is 1.5 degree warming, but in certain parts of the world, they are already experiencing 3-5 degrees hotter summers. Desertification is already happening as is the bleaching and dying of marine reefs.

Moving into Knowledge4.0 economy

The techno-optimist will tell you that digitisation will boost growth and productivity. Everything is changing through the Digital economy. 65% of kids today want to create new jobs and startups. There are 4 billion people connected together and 90% are now online. This story is also happening in Indonesia. But robotization and artificial intelligence has also created insecurity, because today if you graduate you do not know whether you are going to get a job. Even if you do have a job,

[3] Christoph Lakner and Branko Milanovic (2016) *Global Income Distribution: From the Fall of the Berlin Wall to the Great Recession*, World Bank Economic Review, 2016, vol. 30, issue 2, 203-232

computers and robots are expected to take over. For example, do you realise that if I am a lawyer, I can load all the known legal cases into an artificial intelligence (AI) algorithm and, just like today asking a query with Google, I can ask the algorithm to find me the right answer to a legal query. Why would I need to go and see a lawyer anymore? I can just ask Google a legal question. Artificial intelligence is providing a lot of the technical answers nowadays. Consequently, even doctors, lawyers and accountants are being squeezed out of their jobs. They are also insecure and it is this insecurity that is driving populism. "I do not like this so I am going to elect Trump." Is Trump solving their problems or is he just increasing the problems?

We are now moving to Industry 4.0 and Finance 4.0, yet what is Digital 4.0? Industry went from mechanical production to global supply chain to automation using IT, but now we are using artificial intelligence and robotics. That is Industry 4.0. Finance 1.0 was the rise of money, which became unipolar money, but unfortunately under Finance3.0, the interest rate went to zero. I never imagined the interest rate would go to zero or negtaive. When the interest rate goes to zero or even negative, what is your present value calculation worth? You do not know because the valuation of everything is valued by the discounted cash flow method, meaning that the cash flow is discounted by the rate of interest. But if the interest rate is zero or negative, we do not know the true value, which will become infinite or non-estimable. Consequently, the whole valuation model is wrong, but we are now into a multipolar world with the rise of cyber currency.

What does this really mean? What digitization really means is that it costs energy and resources to make something real or physical but it costs nothing to create a digital image or virtual representation of something physical. The minute I create one digital image, I can produce the next digital image almost for free. This is the brilliance of the US dollar. We all want to export to America. We harvest all our minerals to sell to America but what do we get? A piece of paper! How much does it cost to print that piece of paper? Almost nothing. Therefore, are you giving your youth and resources away for another piece of paper? It is very important to think carefully about what you are doing. Digitisation means that the marginal cost of production of digital information is near zero. If you want knowledge, I can pass it to you for near zero cost. The only reason whether you value this information or not is if you want to learn or not. If you do not want to learn, that is fine with me, but I am trying to teach you how to think about the problem.

The Paradigm is the Problem

The biggest risk at the moment is not geopolitical risk, it is not climate change risk, it is the way you think about the problem. If you go around the world wearing glasses that are pink, the whole world is pink, but is the world really pink? Similarly, if your eyes are trained to see the world a certain way, you will be blind to many things that make up reality. It is very important that your paradigm sees what it is. I am trying to teach you not to look at it only from a Eurocentric or economics paradigm. I am not saying that the Eurocentric paradigm is wrong, I am saying that it is incomplete. It appears that we are all like drunkards, stumbling around looking for our dropped keys at night under the lit street light, but it might be the case that the key is lost outside in the dark. Think about it, you go to the internet and you only see 15%, 85% of the internet is dark. Like an iceberg, you can only see the tip but 85% remains underneath the water. The dark internet does many computations that may or may not be legal. Just because you cannot see something, it does not mean it is not there. You must look at problems, therefore, as they are and not as you think they are.

The paradigm is shifting. I am not giving you the detailed information, you can read them later through the references. I am trying to convey to you how I think about it. We are now not yet in a financial crisis but are already in an unfolding political and climate crisis.

In the 1980s, there was a Latin American debt crisis. I was then in Malaysia working at Bank Negara Malaysia trying to sort out the financial crisis because the banks were shocked after Paul Volcker raised the interest rate to more than 11%. Interest rates in Malaysia were, therefore, 15-16% and, as you know, with interest rates of 15-16% you cannot survive. At that time, a lot of businesses went down and I was part of the team to go and clean up the banking problems. That is why in 1989, I went to the World Bank to do research on how to restructure banks throughout the world[4]. Ten years later, in 1997, we had a crisis here in Indonesia, Thailand and Malaysia, which later spread to Hong Kong. As you know, the IMF did not see this coming. Six months earlier, the IMF had given Indonesia the all clear on Article 4 consultations, along with Malaysia. The IMF acknowledged some problems in Thailand, but also thought South Korea was perfectly okay. After July 1, 1997, when the Thai baht was devalued, everyone slipped into a crisis because it was a connected crisis. It was a viral, not individual, problem. Individually, Andrew Sheng looks okay but if I passed my virus to you, you will all have a problem but we could not see the virus.

Then in 2007, instead of a crisis affecting Asia, Latin America or the developing world, advanced economies were struck by a financial crisis, exposing how wrong the prevailing paradigm had been. Ten years later, we are no longer facing a financial crisis because central banks know how to print money through quantitative easing (QE). If you print money you cannot have a financial problem. Basically, you replace debt with more debt. Nevertheless, a political and climate crisis has emerged instead. Every day we see disputes between and within countries, we are facing political crises as a result of failed policies and flawed politics that stop us undertaking structural reforms.

The Chart from Yardeni.com tracks the growth of the total balance sheet of five major central banks (Fed, ECB, Bank of England, Bank of Japan and People's Bank of China) against the S&P 500 index since 2008. The two lines are almost identical. When the central banks increase their balance sheets through quantitative easing (QE), the stock market keeps rising. Did you know that the balance sheet of the Bank of Japan is already more than 100% of GDP? The size of the Bank of Japan is larger than the Federal Reserve. The Bank of Japan owns half of the Japanese government bonds outstanding and through ETFs (exchange traded funds) roughly one-third of the Japan stock market by market capitalization. Before 1997, no central banks purchased equity, but now buying equity is no problem through ETFs. You will notice that when QE started dropping, the stock market also started dropping slightly. That is why President Trump is insisting that the Fed Chairman Mr Powell cut interest rates, failing which, the S&P 500 index will go down and if that goes down, Mr Trump might not get re-elected.

You can see how all this is political. This is really due to the overuse of monetary policy. Why did they over-use monetary policy? They used monetary policy because the politicians refused to undertake very painful structural reforms, including labour market reforms, infrastructure reforms, government reforms and political reforms. They thought it would be too difficult, so they just got the central bank to print money as a temporary expediency. Now they have overused monetary policy and that has become a major financial bubble and inequality problem. In the meantime, however, US debt has continued to grow. Gross debt is now 183% of GDP. Net debt (net international investment position) is already 40% of GDP. By around 2025, net debt will account for around 50% of GDP. In my book, From Asian to Global Financial Crisis (Cambridge University Press, 2009), I discovered that during the Asian financial crisis, any economy in Asia with a net debt of 50% of GDP would have fallen into crisis (with the exception of South Korea). In 2007-08, Spain, Italy, Portugal and Greece, which had a net debt of more than 50% of GDP, immediately sank into crisis. Therefore, when America approaches net debt of 50% of GDP, the only reason America is not in

[4] see Andrew Sheng (ed.) "Bank Restructuring: Lessons from the 1980s", World Bank/Oxford University Press, 1996.

crisis is because the US dollar is the dominant reserve currency. When the whole world still want to use US dollars, why is Facebook trying to create its own cyber-currency? Why do people still want to buy bitcoin? It is because people are no longer as sure about the US dollar as a store of value and means of payment.

The US dollar accounts for 44% of world FX trading. The BIS triennial FX 2019 survey reports 88% out of 200%, because when you cross-trade dollars versus euros you count both the dollar and the euro transactions, so 200%. Basically, you divide it by two to get 44%. Furthermore, the US dollar accounts for 62% of global official reserves. If tomorrow, there is a US war with China and Chinese assets are under sanction, what would the US dollar reserves of China be worth? It could be frozen or confiscated under war conditions. Iran today does not hold any reserves in US dollars because Iran is under sanction but China is a different ballgame. Therefore, the problem is that there are US$11.5 trillion (global GDP is USD80 trillion) in debt denominated in US dollars not controlled by the US Federal Reserve. If an Indonesian company borrows in US dollars, only the US can print the dollars to ensure sufficient US dollar liquidity. If you borrow US dollars, you are in deep trouble when the dollar begins to appreciate in value or US dollar interest rates begin to go up. That is why when the dollar appreciates, the world economy slows and liquidity becomes tighter. That is also what happened in 1997/98, the yen appreciated against the US dollar and then there was a credit squeeze in Asia because the region was essentially a dollar zone. The American Federal Reserve refused to lend us dollars when there was dollar shortage and East Asians got into trouble.

The 2019 BIS annual report has used a very interesting term called zombie companies, which are companies that should be dead but they are still half alive because they live off very low interest rates and QE. As long as QE is there, a zombie company is one that borrows from Peter to pay Paul. The minute that there is no more cheap credit, the zombie company should die but they are not dying. If you then look at the zombie companies, the lower the interest rate as indicated by the blue line in Chart X [to insert], the greater the number of zombie companies because they can afford to survive at low interest rates and available credit. The macroeconomic effect of this is that more zombie companies lower productivity because they are sucking blood from the good companies. That is the productivity outcome of excessive QE.

Why is standard economics wrong?

Standard economics is wrong because mathematical quantitative economics excludes politics. The minute economics became mathematical equations, they took out the political economy and economic policies excluded political interests and behaviour, which is not wholly driven by economics. In reality, economic behaviour is all about politics. I am a member of the Commission on Global Economic Transformation and we were discussing climate change. A very famous economist said that climate change is an externality. An externality is something that you cannot see and are often ignored because of the difficulty of measurement. But climate change is existential. If the climate warms up by a few degrees, we are all going to die, so how could anyone say that it is an externality? Furthermore, it is not a market failure, it is a human failure.

If you think about it, why do we have excess carbon emissions? That is due to excess consumption. We are getting pollution because as long as there are cars out there stuck in a traffic jam, we are emitting the carbon. That is excess consumption because if everybody uses public transport, the amount of excessive fossil fuel burning would decrease and carbon emissions would go down. Excess carbon emission is due to excess consumption but then you have to ask the question of how we got into a situation of excess consumption? The answer is that we could finance it through excess debt. How can the US consume more than everybody else? They can consume more because they can just give you another piece of paper. Excess consumption is financed by excess

debt. Without excess debt there would be no excess consumption. Excess consumption is possible because the interest rate is zero or negative. When the interest rate is negative, you pay me to consume. This is a very strange logic going on where the US or advanced country politics of cutting taxes and increasing welfare, which causes imbalances and inequality, is sustainable only through generating more debt.

QE to lower the interest rate solved the debt crisis by creating more debt. It is as if the cure of drugs is higher dosage of drugs. This cannot be right. We cannot solve climate change or inequality through QE. That is the strange logic of the current central bank QE trap. No one knows how to get out of this trap..

To sum up the big picture, the biggest threat of climate change and inequality comes from the funding of excess consumption by excess debt. None of this is sustainable, which is why we need to understand the role of digital finance and system stability.

Information, finance and digital economy

How should we think about the paradigm of information and finance? First of all, we are now living in an interconnected world. Whatever you do affects me and whatever I do affects you. We all live in a viral world. A hacker can put a virus into your phone that stops you from using it. He can find me on the internet and put a virus on my phone, which would stop me from accessing my bank account or they might take my money away. We are breathing the same air, we share the same water and we share the same earth. If you survive, I survive but if something happens to you then something will happen to me too. We are all interconnected but interconnected through a winner-takes-all power-law. Metcalfe's law says that the value of a network rises exponentially with the number of users. The reason why Facebook is valued at more than USD531 billion is because it has 2 billion customers. If Facebook only had one customer, the value would be zero. Why are so many people currently interested in Indonesia? So many people are interested because the Indonesian population is 264 million. Indonesia's population is a strength as well as a weakness. The larger the population, the larger the domestic market, which is a strength. Nonetheless, feeding the population is a large burden.

Joseph Stiglitz, who was a member of the trustees, received his Nobel Laureate with Michael Spence and George Akerlof on the economics of information. In 2001, when they received their Nobel Laureate, the information age was *just* beginning. Alibaba and Tencent were founded or listed in 1999. Google was founded in 1998. Facebook came later in 2004, Instagram and Uber in 2009. Therefore, the information age is really a very recent phenomenon but we think about it as if it has been here forever. Which is why we need to go into what information is and what it means for our new age.

MIT Professor Cesar Hidalgo has a really good book called Why Information Grows (2015). I highly recommend it although it is not that easy to read because he begins with the physics of information and then he moves into the physics of economies. For an accountant like myself, who went into economics and finally into central banking, appreciating physical and the mathematics of information was not easy. From central banking I moved into policy and think-tanks before I realised that I must understand information before I begin to understand the digital age. Thanks to the Internet, I can now sit in my house and access any book or article that I want through academia.edu. There are also semi-legal websites where you can access any book. The point is that when you start reading and you have the time, you are able to access almost any knowledge available almost to cutting edge level. The reason why we never have the time to read is very simple - our attention span is much shorter these days, just five seconds. To read a book, you need at least

one week but these days, who has got one week to spare? I am retired so I can read all the books that I want.

After I read through many books on information, I realised that digitisation means the information can be copied or replicated at zero marginal cost. This changes the game. Why does Silicon Valley exist? Silicon Valley is actually the conglomeration of five universities near each other, namely Stanford, Caltech, UC Berkeley, UC San Francisco and San Jose State University, a cluster of information and knowledge. At these five universities, professors became innovators. Innovators created Intel, Motorola, Google and so on. If the firms have no time to do research and development, they subcontracted R&D to the professors. The professors subcontracted the work to the students, who went on to start new companies and the students hired the professors as consultants. Do you see what I am trying to say? Silicon Valley is actually an eco-system of knowledge creation – the engine of growth.

Where is the Silicon Valley of Asia? There is no Silicon Valley in Asia because we do not know how to use our universities. At university, people must be educated but somewhere we have forgotten that education is to innovate, to grow and to work as a system. That is the ecosystem. Very few books will tell you that Silicon Valley exists because of Boeing, General Dynamics and the defense and intelligence community[5]. The internet was invented by the US defence industry as a means of instant communication, which was allowed to be used, or commercialized, by the private sector. Google then used that to do the search, and with the GPS (another defense innovation) to create Google Map and today Waze. Essentially, the defense industry was funding R&D, which is the state helping the private sector, which helps the universities and that helps everybody through new innovation and job creation.

The downside of information, however, is that there is also misinformation and disinformation, which can be used strategically for advantage. That is why the United States is trying to stop Huawei because if Huawei succeeds as the dominant player in 5G equipment from infrastructure to mobile devices, then this will marginalize US companies such as Apple, Google etc. The point is that Apple controls the iPhone but Apple is not a manufacturer, Apple creates lifestyle. Huawei is very different because it started as an company building the infrastructure for telephone companies (telcos). From telco, Huawei moved downstream to the mobile phone segment but the moment they entered the 5G market, which allows fast download and upload speeds or driverless car systems to be run on 5G, they changed the whole ball game. Whoever is going to be the Google in 5G is going to be the real success. Suddenly, the US discovered that a company they did not know, namely Huawei, is going to be in that game. This is actually about competitive business rather than national security. It really is about the winning business model in the 5G Digital Age. I am not for Huawei, I do not understand how the company works, but I have bought a Huawei phone to understand how the company thinks. You can only understand a company when you see how they think about their business model. If you understand how they think about the problem, then you can solve how to compete against them. If you do not understand how they think about the problem, you become the victim. As they say, "either eat lunch or be lunch".

Moving onto the information side, here is where economics has gone wrong. As you know, economics went wrong because the theory is reductionist. Life is too complex, so we need a simple theory reduces complexity into a simple equation in physics, such as Einstein's famous $E=mc^2$. Wow, one equation can explain the whole world! Actually, if you think more deeply about such equations, what you really begin to understand is that a theory of everything is a theory of nothing. This is very

[5] For an excellent study of how innovation works as an eco-system, see William Janeway, Doing Capitalism in the Innovation Economy, Cambridge University Press, Second Edition, 2018.

deep but you need to reflect on it. E is energy, m is mass and c is the speed of light, therefore, energy is equal to mass multiplied by the square of the speed of light. From this equation, a nuclear bomb was created. What it essentially meant was that a very small mass can create very big energy. Plutonium and uranium, under certain conditions, can create a lot of energy. That is nuclear physics – a natural science that can be explained in a mathematical equation, $E=mc^2$.

But in economics it is not so simple because economics is about human behaviour. How can I have perfect information when I do not know how people are thinking and people do not know how I am thinking? Between even two persons, there is no perfect information, so how can the whole world have perfect information? Perfect information is an assumption by the reductionist, linear and mechanical paradigm (or world-view) of the Enlightenment because from Isaac Newton (1687) to Adam Smith (1776), the leading thinkers before the Industrial Revolution thought of the physical world in elegant, mechanical terms. But since Einstein's theory of relativity in 1905 and discovery of quantum physics in 1925, we are now in a nuclear world, a relational world in which the world is very different from a mechanical world. The fundamental difference is that there is no certainty, only uncertainty and both physical and human relationships are complex, non-linear and always dynamically changing (namely, non-mechanical).

They say the market can explain everything but the market is a subset of the economy. In the economy, not everything is traded in markets. For example, my wife cleans the house, but that activity is not included in GDP. However, if I divorced my wife and then hired her as a cleaner, her wages are now calculated in GDP. I come from Sabah in North Borneo, what you call Kalimantan. I was working for a forestry company during my youth; the chainsaw and the petrol in cutting down the forest were calculated in GDP, what took 100 years for a tree to grow and the loss of biodiversity is not measured in GDP. The GDP does not measure the loss when the forest cutting increases forest fires, carbon emission and global warming. Thus, the simple measure of income welfare using GDP is wrong. The economy is larger than the market but the economy is a subset of society. A lot of social activities are not calculated in the economy. There are many religious, recreational and cultural activities that are not calculated in GDP terms. How can the market explain the economy and the economy explain society? The market cannot explain society because society is much larger than the economy and much larger than the market.

Furthermore, we human beings are part of the planet and the planet is part of the universe, so how can we use the market to explain the planet and then to explain the universe? That is ridiculous. That everything can be explained through the market is logically so reductionist that it is wrong. The market theory is very arrogant because it not only excludes the political, but also the psychological, sociological, ecological, historical and the planetary aspects of human behaviour. They think they know the price of everything but price (which is formed from the matching of supply and demand) is like a scattering of collision of neutrons etc. You might be able to extrapolate a pattern, but the relationship cannot hold forever into a law like natural science.

If you create a carbon tax as a solution to global warming, who is going to benefit from pricing carbon? Goldman Sachs as a financial trader but not *you*. We need to understand that economic theory is too reductionist, linear and mechanical, so it cannot explain everything[6]. Karl Polanyi, for example, was a Hungarian economist who already questioned the neoliberal market philosophy of Hayek by arguing that the self-adjusting market is wrong (Great Transformation, 1944). Herman Daly was an ex-World Bank environmental economist who argued that "*There is something fundamentally wrong with treating the earth as if it were a business in liquidation*.".

[6] For a good survey of why the neoliberal paradigm is obsolete, see Stephen Toulmin, Cosmopolis, 1990.

If we step back to think about the history of physics, up until 1905, Newton physics was still the accepted knowledge. But after 1905, when Einstein invented the theory of relativity, he saw everything in relative, not absolute terms. The earth moves relative to Mars, relative to the moon. The classical world view was that the natural world operated mechanically like a machine. They thought the atom was the smallest particle, in 1925, the more they studied the atom, they discovered smaller particles like protons, neutrons and so on. Thus quantum physics was the study of the small, opening up complexity and uncertainty. Quantum physics essentially made the mechanical world obsolete. The old worldview was materialistic.

But a simple quantum physics experiment – the famous shining a laser light through two slits produced not two sharp slits as expected, but a band of light and dark light. This meant that light is both a particle and a wave at the same time. Intuitively, we acknowledge this since no human being is only good or bad, but can be both good and bad at the same time. Nothing is absolute, but everything is relative to something else. This quantum view changed the perspective from absolute to duality and from reductionist to exploding complexity. Instead of something becoming more and more simple, the world became like a Big Bang - more and more complex. Just like when you use a telescope to see the universe, you realise there is a galaxy and beyond that are even more galaxies.

If that is the case, what was supposed to be deterministic became probabilistic. If light is a particle, you might be able to locate it, but if it was both a particle as well as a wave, it could be anywhere. We only know probabilistically where the particle is, but it could also be anywhere.

Let me explain the difference between the physical and the virtual, the material and the digital, by using a piece of paper and a glass of water. I was very apprehensive when I started reading about quantum, I did not understand what quantum was. As an accountant, I understood double-entry accounting, so I slowly began to appreciate that quantum is both reality and imagination at the same time. What is reality? A glass of water is reality; you can feel it, you can touch it, you can hear it and you can drink it. Glass and water are real, physical and material. A piece of paper can be designated as a derivative of the underlying asset. This glass of water is represented by this piece of paper. Suppose I am a derivative trader. Every time I tear the paper into two pieces, and I drink a gulp of water as my fee for creating the derivative, the two pieces of paper, which previously was denominated as one dollar in value, may now be worth two dollars, provided someone is willing to buy each at price. This is how the financial derivative market works – persuade someone to buy the derivative rather than the original underlying asset. Thus, I can sub-divide the paper into 2, 4, 6, 8…64, 128, 256 etc, similar to how digital memory goes up in multiples of two.

Notice that it costs me almost nothing to create more and more derivatives. In other words, the pieces of paper represent digital derivatives, because I can create this digital replication as many times as possible. Furthermore, whilst I can create more derivatives digitally, the underlying real asset - the glass of water remains. However, because as the middleman, I extract my fee, the increasing number of derivatives now represents smaller and smaller amounts of water in the glass. Once the glass is empty, what is the value of the derivatives? The derivative originator may know, but if you are the holder of these derivatives, you do not know whether I have drunk the water or not. You are still busy trading the pieces of paper (the derivatives) as if it was worth a lot of money but somebody already drank the water. That is what happened to CDO and CDO-Squared and that is what happened to Lehman Brothers. This is in a nutshell, was the sub-prime mortgage derivative debacle. Financialization through derivatives is like a Ponzi game. The scale goes larger and larger until it implodes.

In quantum terms, the relationship between the derivative and the real is the entanglement. They are entangled together whether you like it or not. When two things are entangled together, without

a specified relationship, this is sometimes is known as the Chaos Theory. A butterfly in the Pacific flaps its wing and creates a tornado in Asia. Why? Because the flap of its wing changes the atmosphere, which raises the temperature and warms up the ocean and the ocean creates a tornado. There are connections that you do not understand but there is a connection.

Quantum theory basically changes our perspective because everything is in the realm of possibility. Once you begin to appreciate that, you would realise that there is no such thing as objectivism, everything is uncertain and probabilistic. Quantum behaviour is weird but it works. Today, we have quantum computing, quantum cryptography, quantum biology and so on because suddenly both natural and social scientists discovered quantum ideas can work in practice. They do not know why it works but it works. That is why they are worried about quantum cryptography because if I had quantum cryptography, but you do not possess quantum cryptography, I can read your mail, but you cannot decipher my mail. I therefore have a competitive advantage over you.

In short, classical and quantum are very different worldviews. Economics is still classical, because the pretence of perfect information enabled a simple model that ignores relativity, systemic feedbacks and random or uncertainty shocks within and without the system. In essence, mainstream economics has ignored the meso/mezzo side of institutional processes, standards and feedback. Basically, we study macro and we study micro, assuming that the meso/mezzo institutions and individuals do not change or adapt through the creation of new information and knowledge. We are all part of a system and individuals and institutions influence the system as a whole, just as the system affects all of us. Mainstream economics is therefore incomplete, and incomplete worldviews are fundamentally flawed..

Systems thinking

The first thing that you need to understand in systems thinking is not to think as yourself completely outside the system (as an objective observer) but think within the system - how do I affect the system and how does the system affect me? You need to understand it systemically.

We can think of the global economy as the evolution of a more inter-related historical, financial, real and economic business system. America, being the dominant economy and consumer, basically created the Asian and European supply chains to produce goods for American consumption. Japan started selling consumer goods to America and Germany started selling cars to America. Overtime, Germany dominated the European supply chain and Japan became the hub of the Asian supply chain. The Asian development model was all about plugging into the global supply chain. Plugging into the supply chain is the same as plugging into Google. The minute I plug into Google, I can access the whole Internet information system. When I plug into Facebook, I have access to the whole world through Facebook users. Except that I forget, Facebook and Google also have 100% access to me and my private information. We are all interconnected in a network. The global supply chain started with hardware, but gradually became more sophisticated with knowledge-embedded hardware, services, data and software. Most Asian manufacturers and policy makers are still stuck in their hardware mentality, forgetting about how the software controls the hardware.

The best way to think about this system structure is our personal computer, which became truly useful because we had software like Microsoft Word, namely, how to type, store and conveniently transfer information. Then we added Microsoft Excel for calculating and analysis. Furthermore, we added PowerPoint to facilitate presentation and communication, Individual programmes like PowerPoint can perform better when they can work with Word, Excel, Outlook and other devices. This is where the operating programme Microsoft Windows controls the specialist programmes. The software controls the applications that run on the hardware that are connected via the network.

The machine is only as powerful as the software that runs it. The tools are only as good as the brain that uses them.

Thus, to catch up with the leader in technology and default global consumer – the US, Japan learnt to make the hardware but did not pay enough attention to the software. Japan became number one in the Asian manufacturing supply chain, expanding and sub-contracting the manufacturing to cheaper labour markets in the rest of East Asia. India was a late-comer in manfuacturing, so she developed software skills. Fifteen years ago in India, TCL, Infosys, Wipro etc were world leaders in writing software. But today where is the Indian equivalent of the Chinese WeChat or Alibaba? They missed the chance to move up to the next level of innovation into digital platforms.

Basically, the impact of technology on finance was to speed up communications (transfer of information), widen the market network and reduce costs of intermediation. Finance 3.0 was based on trade finance but evolved first into credit and then derivative markets. The digital revolution reduced the cost of entry for everybody, so that margins got compressed and others could innovate to take away the old franchises.

The importance of scale enables new entrants to gain market share and then build up monopolistic powers. If there is a big market like Indonesia, China or India, new competitors who enjoy economies of scale actually can develop very well. Why is there no Google, Facebook, WeChat or Alibaba in Europe? Europe is not a single market. Europe is made up of many small national markets that are inclined to protect themselves. Consequently, Google and Amazon came in and cut through national barriers and gained market share. Essentially, businesses have become platforms that integrate disparate markets and sectors previously dominated by specialists. They are multidimensional platforms that network disparate networks.

What is FinTech? It is actually technology linking finance with the real economy, bringing in logistics, lifestyle, consumption and production. Therefore, digital is a hybrid evolution, not linear integration into one product or sector only. That is why everyone is scared when Facebook signalled its intention to move into cybercurrencies with Libra. When Facebook moves into cybercurrency, it will automatically have 2 billion customers. The largest bank in the world may have at most 100 million customers. That will be the end of the banks if everything can be cleared through Facebook. But trust is still the key. The reason you use Facebook is because you trust Facebook but are you sure you can trust Facebook with your money? Are you sure you can trust Google not to use your information against your interests? There are many trust issues with the new Tech giants.

The emergence of Quantum Information

Quantum economics is beginning to emerge and quantum economics is the new science of money. I recommend you read the book by David Orrell (2018) on Quantum Economics. He gave me the book to review but it is not easy to read because you have to understand quantum physics concepts. Once you understand these quantum ideas, the issues begin to make sense. To go back to the Big Picture, it helps when you see it from 30,000 feet up that what has happened in the world today is that FinTech evolved from three issues concerning globalisation, technology and competition, with three levels of networks. The first is physical trade networks, which is the global supply chain. If America wants to import oil from the Middle East, that is physical. You have to physically ship the oil from the Middle East to the United States. Then, you have to pay and you pay in US dollars. The minute you pay for oil in US dollars, it is already the most important part of the transaction. Now, however, America has told Iran they are not allowed to use US dollars. The Iranians have to trade in something so maybe they are selling in bitcoin, Chinese renminbi, Russian roubles or whatever.

The second level is finance, but you will notice that the value of financial transactions is three times the transaction to support each physical trade. Every time you give an order to transmit a payment, there are many transactions behind that. Your bank has to process many bits of information. Therefore, every time you want to export a commodity, the bank behind the scenes has to process, match and coordinate many information instructions, from bank to importer, to shipping company, to the insurance company, the receiving bank, final customer and so on. There are many financial transactions just to facilitate one physical transaction.

The third level is the data network. Now that everything is done digitally, and we have 20 times the internet speed using 5G, massive data transactions are already happening. Given these three levels, if you only dominate the physical level, that is not sufficient. Saudi Arabia is the world's largest oil producer but is it a powerful country in the world? Maybe. Finance is still the most powerful, which is why America is the most powerful. But today, data has become the most important factor, so whoever has the data is number one. Without data, there is no artificial intelligence because artificial intelligence depends upon data. If you do not have data, you have artificial stupidity! You cannot process information if you do not have the data.

What is data? Chart XX from pioneer digital thinker Robert Lucky (Silicon Dreams, 1991) shows the value of data as a pyramid. Raw data has no value but data has a value when you process it to become information. When you classify the information and you analyze it, it becomes knowledge that is more valuable than information. But the highest level of knowledge is wisdom. The value of data rises as it reaches wisdom, but data in communication theory terms is negative entropy. Entropy is a concept from the second law of thermodynamics that basically is linked to complexity. Essentially, entropy increases with complexity, but the beauty of the insight of communication theoretician Claude Shannon in 1948 was when he got the idea that information is negatively related to entropy. In very simple terms, entropy basically means complexity, disorder or uncertainty. More complexity equals less information. From this, Shannon deduced the information standard, which can be measured in terms of bits (0,1), so that his theory can measure how a receiver can communicate efficiently with a sender through a channel with minimal loss of information.

The trouble with information communication is you can have positive information, but also negative information, misinformation or disinformation, which all play into strategic decisions. Positive information is good information but it can be negative information if that information cannot be trusted, it is false or misleading. If I cheat you by providing wrong or misleading or incomplete information, how do you know you have been scammed? You do not know. You would only know if you have another source of information to verify whether the information you receive is reliable, factual and can be trusted. There could be disinformation or misinformation by only presenting half of the story, which would also lead to your mistake in decision making. Information can also be zero; zero means no information.

We usually think about information is virtual and a flow, like receiving a stream of information. Now we get to the deep issue that information is *physical*. This is what most people have difficulty understanding. If you read the book Why Information Grows by MIT Professor Cesar Hidalgo, he makes the remarkable point that information is also physical, just like energy, which is used to heating silicon at the right temperature to make the physical glass.

I can convert energy into the physical but actually information can also be made physical. What is oil? Oil is the fossil remains of dead dinosaurs and plants. These fossils contain very valuable information that was captured and made physical. Why were there dinosaurs and why were there plants? They were there because the energy from the sun became photosynthesized and converted into plants, which also became food for dinosaurs and other mammals, and over billions of years,

their remains became fossil fuel, which is physical stored energy and information. Today, we burn the fossil fuel to take the energy out but when you look at a fossil fuel, you realise that the fossil fuel has information. For example, amber is fossilised tree sap that sometimes contains an insect inside. If the tree is 10,000 years old, the insect is also 10,000 years old, so it contains information. If I can see the insect and extract the DNA, I may be able to clone that insect back to life. That is information. The amber, which looks like a little piece of stone, has lots of information in it. How does this relate to us?

A battery stores energy when it is being charged. The physical battery captures a flow of energy and converts it into physical form. So we can draw energy from the battery, except that the battery also leaks. Think about it, we put money into a bank, actually we are giving information to the bank, the bank takes your information, your dollars or rupiah, and the bank behaves like a battery. If the bank has non-performing loans, that is the same as a leaking battery. If somebody in the bank is stealing, that is exactly like the battery leaking energy. Why do we need to protect the banks? Because we do not want them to leak. Why do we have the battery? Because the battery is useful. Why do we have a bank? Because a bank stores value and can help transfer funds in a trusted manner. If everything is stolen from the bank, the bank is not useful. Therefore, information can be negative and physical. Now you understand that finance is information across networks.

The idea that information is physical and also hierarchical came from MIT. After writing about digital finance and publishing it in the Internet, I got this feedback from MIT Professor Alex Pentland[7], who suggested that he has presented the architecture of finance in graphical form as the competition between vertical hierarchy of finance versus a flat network. This goes to show the power of the Internet and near instant feedback. What Professor Pentland said was that a P2P network is finance information that is transmitted through different accounting ledgers. Put very simply, Andrew Sheng wants to send some money to Bambang. Andrew Sheng sends an instruction to CIMB Niaga Bank to remit to Bambang at Bank Mandiri. I give information to CIMB Niaga and then CIMB Niaga debits Andrew Sheng account and credits Bambang across its accounting ledger. The money is received by Bank Mandiri and Bambang is credited. Therefore, the information has travelled from Andrew Sheng to CIMB Niaga to Bank Mandiri to Bambang (P2B2B2P).

Next, Andrew Sheng wants to remit the money to Pedro in Brazil. Andrew Sheng instructs CIMB Niaga, CIMB Niaga instructs New York Citibank, Citibank instructs the Federal Reserve in New York to pay the money in US dollars to JPMorgan, JPMorgan instructs Banco do Brasil, which remits the money to Pedro in Latin America. This is a vertical hierarchy of ledgers. The current global financial system is a hierarchical system in which you clear transaction in US dollars across the books of the Federal Reserve at the apex, and the Federal Reserve of New York can see all your transactions. If you transact through Facebook, Facebook can see all of your transactions. What is blockchain and what is P2P? P2P removes the bank as the middleman directly through blockchain so nobody else can see the transaction using a distributed ledger. A distributed ledger is very simple: I give an instruction to this blockchain, the blockchain algorithm calculates an encryption and passes the information (the block) to the next ledger, where another calculation is performed onto the next ledger and so on. This is a flat process, not a hierarchy. Nobody can crack Ledger 1 but if they do, they would be unable to crack Ledger 2 or Ledger 3. This is a flat process from person to person (P2P), not a vertical hierarchy going up and down the chain of command. You trust CIMB and you trust the Federal Reserve but do you trust blockchain? Who is blockchain? Who certifies that the blockchain cannot be hacked or scammed? There is still a trust problem.

[7] Alexander Lipton and Alex Pentland (2018), Breaking the Bank, Scientific American

Once you understand this, you realise that the unipolar financial system is a top-down system with the US dollar as a core reserve currency but blockchain is a flat P2P system. The current system is an official or fiat money system because you are transacting in rupiah or US dollars. Today we have a mixed system, because we have both official systems that are supposed to be transparent and in the light. But the blockchain is dark money. Nobody knows who I am transacting with when I do it through bitcoin or maybe you think you do not know. Somebody knows. When I operate an international coin offering (ICO) or cybercurrency exchange, the operator can see those who use the system but the user cannot see the operator (it depends on how the system is designed). The trouble is that you have to trust blockchain but who certifies that it is blockchain? Nobody. Therefore, you trust that the blockchain cannot be cracked. But blockchain can be cracked; anything that has been invented by human beings can be superceded through innovation. Every time you build a 100-foot wall, someone will invent a 101-foot ladder. This idea, therefore, about blockchain being uncrackable is nonsense. The question is whether you trust it or not.

Once you understand this, the IT forces us to rethink the basics of finance and money. Once you understand that the basics of finance is information and information can be physical behaves in a quantum manner, you will suddenly realise that it is not so simple any more. It is all about trust. If you trust US dollars, very good, but if you do not trust US dollars, you will have to use something else. Who do you trust? Therefore, finance is a derivative of the real economy: the glass and the paper. Do you trust the glass or do you trust the paper? Most of us use paper now and, in fact, we no longer use paper, we use digital ledgers and digital information. The link between imagination and reality is trust. Between the real and the virtual is trust. If you do not have trust, it does not exist. That is why people trust gold, they can feel it but if you are a refugee can you carry gold? You cannot carry gold through fear of it being stolen. That is why they buy bitcoin and carry the password in their head.

In sum, we need a change in our perspectives of FinTech. There is a lot of information but also a lot of disinformation and misinformation. I am trying to teach you how to understand it like a layman and get down to the basics.

What is the secret of finance? Speed x Scope x Scale. A lot of foreigners did not understand how FinTech succeeded in China, until one day a very smart Chinese startup investor wrote on a white-board: Speed x Scope x Scale. Speed means you can get there very fast. Scale implies China is a very big market. Scope means that the tech platform can do finance as well as something else. Alibaba is not a finance company. Alibaba started out as the Chinese eBay but they soon realised that the eBay model cannot work in China so they started with a logistics model for small businesses to sell their products. Because they worked through the mobile phone (and by-passed the PC), they connected half a million small and medium enterprises (SMEs). The moment they had half a million SMEs, they were reaching out to maybe up to 400 million customers. After that, they introduced Alipay to facilitate payment and also TaoBao, as a place to store their value. Architecturally, Alibaba is an eco-system because the platform connects the whole system together.

Tencent did not start as Google, Apple or Amazon. Tencent started as a gaming company. Chinese people like to use the phone to play games and suddenly they had 200-300 million customers. Once they had that many customers, they suddenly realised the benefit of launching a messaging system, like Instagram or WhatsApp. Then you can add video to the platform and become like YouTube. Therefore, WeChat is actually YouTube plus Instagram plus WhatsApp social media. Now, you can use WeChat Pay to transmit money very cheaply. Different business models create different markets and digital platforms that interlink different markets. Speed is important to enter the market very quickly. GoJek is a similar example. They took the Uber model and designed it for the Indonesian market. Uber only thought of cars but GoJek started off just using motorbike transport.

If you think very differently, you suddenly have Speed x Scale x Scope. Once you create a different marketplace, that becomes the business model. FinTech is basically B2C, B2B and P2P networks. Not really that difficult.

Actually, the game is already over for FinTech. I am sorry to say this but the FinTech business model is no longer to service you as the customer. The FinTech business model today is to acquire a few thousand customers with a very good idea and then go to Apple, Albaba or Google to sell the idea for a unicorn price. That is the current business model of FinTech. You will notice that a lot of smaller startups eventually get bought up by the Big Tech for billions of dollars. Therefore, the FinTech business model is no longer just to create business, it is to create a business to sell to somebody else. The Big Tech wants to buy up innovative ideas, either to use or to block others using. So in a competitive sense, the Big Tech will increasingly dominate the FinTech business.

What are the lessons? I am only asking the questions and I think you should know this. Being successful in life is not about knowing answers, it is asking the right questions. Very often, you must learn what the right question is. For example, is Apple a phone seller? No, Apple does not sell phones, Apple sells a lifestyle. I have an Apple phone, so I am very cool. After all, I could buy a Nokia, Blackberry or Huawei but I bought an Apple. It is white and very cool. It is a lifestyle. Actually, you must think very clearly about each company' business models, which can be very different from what you think they are. For example, GE is usually thought of as a manufacturer of equipment, but it became a finance company that was highly leveraged (now getting out of this model). Are illegal FinTech deposit and credit schemes scams or are they real innovations? We often hear about regulatory sandboxes. This idea emanates from the Bank of England to enable the licensed banks to innovate within a regulatory sandbox that gives they room to play slightly outside their regulatory limited scopes. The problem with this approach is that when you treat people as kindergarten they will always remain in kindergarten. When I was growing up, my parents taught me that I must be very good. When I grew up, I realized that there are many wicked and bad people out there. It was not that I wanted to be bad, I just had to be afraid or cautious of people who are very bad, who might do bad things to me. When you only stay in kindergarten, you cannot compete. You have to go out into the dark world and fight until you learn how to win. You do not want to be bad, you want to be good but in order to be good you have to fight the bad. You have to understand how the bad works because you are competing with a world of both good and bad people. Mentally speaking, when you are in a sandbox, you cannot succeed because you are only looking at the sandbox. You are not slaves or children; you are adults competing in the world of adults. You are no longer competing at the Asian or local games. To be world champions, you have to think and perform like the current Indonesia world badminton men doubles champions Hendra Setiawan and Mohammad Ahsan, who became champions, lost it and became world champions again. To become world-class, you cannot think and act like in kindergarten sandboxes.

Blockchain is a very good example of the element of trust in FinTech. Who certifies blockchain? Nobody certifies blockchain, so you take a real estate company that is losing money and simply change its name. The real estate company then claims it has become a FinTech company dealing in Big Data, Artificial Intelligence and Blockchain, and its share price goes up. This could be real or it could be a total scam. Therefore, claiming to use blockchain does not necessarily mean that it is a real blockchain technology that is efficient, trustworthy and unhackable. Governments are not certifying blockchain as a legal standard. What are the benefits of cyber-currency? How can we control cross-border digital scams? These are big issues. Because the issues relating to digital data usage are very technical, it is important for you to understand that the minute you begin to ask the right questions, then you can often dig out the answers through Google. I do not need to give you the answers because most answers are already available in the Internet. All that remains is for you to have the time and patience to dig until you arrive at what you consider is a satisfactory answer.

The latest BIS Annual Report on tech platforms say that they bridge many sectors, but only 11% is finance. Therefore, Big Tech is not dominant in finance, but they are big enough to take on the banks. Consequently, the banks need to understand that they have no time to remain playing in the sandbox. The real issue for the banks is how to compete against Big Tech. If they allow Facebook to get into payments and take deposits, they will have 2 billion customers. The biggest bank in the world, namely ICBC in China, has only 100 million customers whilst HSBC has 20 million customers. How can the banks compete?

You need to understand that the tech platforms play a very different business role. Big Tech has competitive advantages over banks in terms of technology, scale, speed and scope, except in terms of regulatory protection. The only reason Big Tech has not worked in European finance is because the Europeans do not allow it. The only reason Google and Apple are not active in finance is because they would have to satisfy all the regulatory requirements such as capital, liquidity, customer privacy protection, AML, anti-terrorist funding etc that are too cumbersome. The only reason WeChat and Alipay work well in China is because the Chinese regulators let them. If direct competition cannot work, business cooperation has already begun. Banks are starting to work with Apple, Google, Alibaba, WeChat etc and some of them want to work with Facebook Libra.

The core issue in FinTech is therefore a regulatory issue whether a level playing field can be built between banks and Big Tech and then how to regulate so that both sides comply with the level playing field? Are digital bank licences the answer? Given the large sanctions that are now being applied, what is the strategic consideration concerning business models going forward? I do not have answers to all of these questions. I personally may have some ideas but they may be wrong. All I am telling you to do is ask the right questions and find out the answer yourself.

Digital Money and Financial Stability

What is digital money? Agustin Carsten, the general manager of the Bank for International Settlements and former governor of the central bank of México has presented an excellent paper[8] and chart on the functions and scope of different forms of currency [Insert chart]. Just During the Second World War, nobody in Malaya and Indonesia trusted the Japanese banana currency notes, and as it was forbidden to use Sterling, Dutch Florins or Malayan dollars, they used cigarettes as currency. The Mexican Tumin is like such currency, created in an area in Mexico where there were local difficulties in using the Mexican peso so they invented and used Tumin. This suggests that currency can be evolved privately if people accept such tokens as currency.

There is a key definitional issue when money evolves from physical token to central bank money to cyber-currency. In technical monetary economics terms, M0 or base money is central bank base money, which is the money the banks place with the central bank. M1 is MO plus the commercial banks' current account deposits. M2 is M1 plus the fixed deposits and savings deposits and then M3 includes non-bank deposit accounts. M4 includes deposit substitutes, like shadow banking, and finally, M5 includes bitcoin et cetera. Once you understand the concept, it is actually not that difficult.

The difficulty in maintaining system stability with different concepts of money is whether the concepts are stable and will impact on system stability through contagion.

Today, with the internet, if you have the courage, you can get any information you want for free. It is only whether you have the courage and the determination to get that information. Cyber-

[8] Agustin Carsten, Money in the Digital Age: What Role for Central Banks? Bis.org, 6 Feb 2018

currency is basically used for capital flight, tax avoidance and some illegal activities that want to avoid official surveillance. This is the experience with the Chinese renminbi and the price of bitcoin.

To appreciate the evolution of FinTech, we need to understand that there are now at least four internet models[9] . There is the Silicon Valley internet model, the Chinese state-run model, the European GDPR (General Data Protection Regulations) model, a US Government private model, and also I have included an Indian model. The potential Indian model is very interesting. The population of India is 1.3 billion people but only 30% of Indians have a bank account. In 2016, they created the Unique Identification Authority of India (UIDAI), so that everyone in India can have a unique smart ID (Aadaar). The minute you have a smart ID with a chip, you actually create a bank account. In Malaysia, my ID card has a smart chip, which can store value and use for contactless payments. Technically speaking, the Reserve Bank of India can actually be a central bank that is digitally linked to every holder of the Aadaar card, so everyone has a unique bank account with the central bank. Each salary could be deposited onto the unique card with biometric identification so nobody can steal from it and then all monies could be transacted through the Reserve Bank's cyber-currency. This is all technically possible but the Indians have not done it yet, because the current banking system is not just a large player, but also a huge employer and job creator.

The European GDPR, or General Data Protection Regulations, actually has narrowed the ability of banks or Big Tech to compete at the global level. By regulatory protection of private information, the market can shrink very sharply. Consequently, the Europeans have a dilemma, because it is not clear whether with GDPR, they will be able to create a European Google or Facebook to compete at the global level. Basically, they hope that the rest of the world would migrate to the GDPR standard. The US DC model is different from the Silicon Valley model in respect of the Government in Washington DC determining what level of regulation that will control the Big Tech in terms of anti-trust, data privacy and such public concerns.

Finally, there is also a Russian disruptor model, which means that if I crack your software, your network becomes my network. If the Russians can read Google, they can read all of your information. That is the disruptor model. What I have done is to show that there are many possible Internet or Internet finance models out there, and how the system as a whole will evolve is still up for grabs.

Having now understood the concepts and models behind Digital Finance, we need to move onto systems and system stability, which is the purpose of central banking. In 1979, the Harvard professor and sociologist, Charles Perrow, was appoint4ed to look at the failure of Three Mile Island, a nuclear power station in the United States. The power station stopped but it did not blow up like Chernobyl or Fukushima. From this experience, Charles Perrow wrote a book on the fragility of complex systems. When a system becomes too complex, it sometimes fails and we do not always know why it fails. When you want to maintain system stability, you cannot think like normal economists, you have to think like a sociologist. A free market economist assumes that when a market system receives a shock, it will revert back to equilibrium. A sociologist will tell you why certain people behave in a certain manner and create a crisis. When the system becomes extremely complex and linear and too tight, how much of the system do you actually use? Maybe 3%. When they sell a smart TV to you, how much of it do you use? I just switch mine on and go to YouTube, even though the TV is programmed to do many more complex functions. We all know that the more complex a car, the more prone it is to breakdown. When the system becomes too tightly coupled (linked together with little room for error) and too complex, the system begins to fail.

[9] Kieron O'Hara and Wendy Hall, *Four Internets: The Geopolitics of Digital Governance*, CIGI Papers No. 206 — December 2018

Let me give you a simple illustration, from a book is called Meltdown[10]. If you were to go into a Boeing cockpit, it looks similar to a car cockpit. It has a steering wheel that you can steer left and right. There are also many dials. How did the problem occur with the Boeing 737 MAX crashes? It happened because the software was written in such a way to correct for the plane's stability. When the software missed, however, instead of the plane going up it overcorrected and created a stall, causing the crash. That is when it became too complicated. The 737 is a very well-proven aircraft but when they amended the software, they did not think through how the software would impact pilot behaviour under certain circumstances and nobody checked until there was an accident.

When you look at an advanced banking system, the banks failed in America in 2007/8 because the system got too complex. That is why I am against Basel III as a set of very complex regulations. Basel III was designed for a complex cancer problem for advanced country banking system but we in emerging markets do not have cancer, we have dengue fever. Most of us get sick because of dengue, so our problem is public health, not cancer. So, why are we taking Basel III cancer medicine when we do not have cancer? Look at America, what has happened with Basel III? We have spent 15 years discussing Basel III and then America said it would only apply to a few G-SIFIs, basically exempting all the community banks. In Europe, they said that the European regulation is better than Basel III but what they do not tell you is that every member country has national exemptions. When you remove the national exemptions, very few European banks except G-SIFIs are following Basel III. What has happened 15 years later? The emerging market banks are beginning to take cancer medicine, but the West has eschewed the cancer medicine. I am simplifying a very complex argument to make a simple point. When the system becomes too complex, the dominnat players think that with a level playing field, if I take cancer medicine you must also take the cancer medicine. This does not make sense.

Since we are concerned about the stability of very complex systems, we have to understand that complexity. Then we need to think about systemic risk from digitisation in finance. My point for you is very simple; initially, digitisation was very new but over time digitisation has already become mainstream in the real economy. We also know that overtime, systems will become larger, faster, and more complex. Fifteen years ago, there were no smartphones. Now, e-commerce has already become mainstream, since all businesses must adopt e-retail strategy and use digital technology in production, distribution and finance. Actually, the fundamental ideas about financial stability are the same as before, you only need to understand what digital is all about. If you understand what digital is all about, you suddenly realise it is the old thing in a new dress. Do not get awestruck by technical experts, go and understand the What, the Why, the How and For Whom of digitization? The basic goals of financial stability are the same as before, except that we now have new tools. The regulators must catch up on digital skills, without which there will be leads and lags and gaps in understanding. That is more a mental barrier because the information is already available on the internet. Andrew Sheng did not manufacture all this information you heard today. I just went to the internet and extracted the information that I thought you might need.

What are my policy suggestions? Digital information is about data. Without data you will have no artificial intelligence. The best computer cannot work without data. Where is your data? I am sorry to say this but a lot of your data is with Facebook and Google. You have given your information freely to Facebook and Google and Indonesia has the fifth largest national user base in the world. Why do you not ask for that data back? That is my simple policy question.

[10] Chris Clearfield and András Tilcsik (2018) Meltdown, Penguin

Those of you who are in academia, you want to write a PhD thesis. You may want to write an academically accredited article. How can you write that article if the data you use is in the United Nations or the United States? You have no competitive advantage. You only have competitive advantage if you write a policy paper based upon Indonesian data, but where is the Indonesian data? Facebook and Google have already taken it all. Is that not funny? You have given them your data for free and you have got very little out of it. I am sorry to say that we have suddenly realised we have been persuaded to give our data for free to somebody who then uses that private information to make money. I do not mind giving my data to Google, the problem is I do not know who Google have sold the information to. Also, if somebody hacked Google and uses my information against me, I will receive no compensation except the free use of their search engine. Instead of using Google as my favourite search engine, I can use Bing. Why do I not use Bing? Because I like using Google and I like using Google because I think it gives me more information. That is not true - if I use Bing I can get as much search information from the Web. Therefore, you are persuaded by advertisements that tell you what *you* like. We need to think for ourselves, nobody is going to look after you. America First means America First. You need to think for yourselves, formulate the right policies, acquire the data and move up the AI chain.

Let me stop there because I have given you a lot of information that I know is difficult to digest. Let me tell you that it was very painful for me to research for this lecture because in writing this, I realised that for the last 40 years I have been wrong but in order to succeed you must admit that you are wrong. Let me give you a simple illustration. Most of you play badminton so you would know that Lim Chong Wei is one of the best badminton players in the world, but he could never beat Lin Dan. Physically, he was as strong but mentally he would become scared as soon he met his opponent. Only when he was suspended did he realise that it was all mental. When you mentally prepare yourself to be a leader, to be the best, you not only have to become the best, you must prepare yourself to be the best and you cannot become the best unless you pay and work very hard for it.

On that note, thank you very much.

Question and Answer Session:

Question 1:

What policy should Indonesia take to reduce the negative effect of asymmetric welfare on trade because in Indonesia, trade of natural resources is often disadvantaged? This is a big problem in Indonesia.

Andrew Sheng:

I am not a trade expert but to me the issue is very simple. Indonesia is very lucky because Indonesia is situated in a very good neighbourhood. Indonesia is in ASEAN. In ASEAN, we have agreed to have almost zero tariffs within the community. The reality is that in this trade war, everybody needs ASEAN. You do not need to choose between the Chinese or the Americans or the Russians or the Europeans or whoever, they will open to you because they need you as a neutral trading partner to compete with the other trading blocs. Indonesia is, therefore, in a very advantageous position. Let me put it this way, if you today are situated somewhere in the Middle East, there are wars all around you, could you succeed? It would be very difficult. We have peace and stability in this region. ASEAN was formed from the Zone of Peace, Freedom and Neutrality (ZOPFAN) and because we have had 50 years of peace, we are now where we are. If we were somewhere located in the Middle East, it would be more difficult. Thanks to God, ASEAN has good weather, good soil, good people, peace and stability. If we keep it that way, we will grow. I do not worry about trade.

Question 2:
I agree that we have to be ahead of the curve to win the game. Perhaps you have heard about MMT (Modern Monetary Theory). It is really interesting where the government now has control of money supply, no longer the central bank. There are no constraints from the central bank and from tax revenue. Are the older monetary theories still relevant? Is this a joke or is this a reality that we have to face?

Andrew Sheng:
MMT works in America because America is a too-big-to-fail borrower. You are forced to lend to the Americans because they are the major reserve currency. If any other country tried MMT, they would have serious problems on their hands because they cannot print dollars. The Americans have a huge advantage over everyone else because everybody else needs dollars. Whenever America gets into trouble, they just print more dollars. As much smaller economies, we cannot print our currency without either devaluation or inflation. We are stuck, in the sense that we are still in orthodox economics and orthodox monetary theory, whereas America can talk about modern monetary theory because they have discovered that they can actually print money. The issue is also that they are very big. We have a very strange situation, the world is facing two things: inequality, which means that the rich are getting richer and the poor are getting poorer; and climate change. At 0% interest rate, why is the government not spending money on infrastructure or on solving inequality? If central banks can borrow at 0% interest rate and use central bank money to invest in climate change infrastructure or in inequality, then you would actually get growth. When you have growth, you can pay off the debt. If you have no growth and only debt, then you get either inflation or devaluation. That is the reality.

Why are the central banks in Jackson Hole in deep trouble? They do not know what to do. The old model told them that they must listen to the politicians but the central bank must be independent. Now, the politicians are telling the central banks to do what they are told, which may not be for the best. In that case what do you, as a central bank, do? This is unheard of. We are already in new territory. Where else in the world would the president tell the central bank governor that he is an enemy of the people? It is just unheard of. Modern monetary theory is appealing because they realised that they can actually use this money for infrastructure in America. If you have been to America, you will know that it is a first-world country with third-world infrastructure. They can also use this money for climate change and all the other issues. It takes a very good central bank and a political system to manage that money properly. Good resources in good hands become even better. The danger is good resources in bad hands, which become worse. That is MMT. Frankly, MMT is not available to emerging markets. If emerging markets were to print money like that, they would run the risk of either devaluation or inflation. There is a grey area in which you can use a lot of this theory but the way to think about this is not to run it unless you are sure.

Question 3:
From your very rich explanation, what do you think is the most crucial area to be addressed by Indonesia and by Bank Indonesia? If I am not mistaken, one of your main points is that there is nothing really new under the sun but right now we are confused by so many details, like the current account deficit, and we also have structural problems. What do you think are the most crucial yet doable things for Indonesia right now in this world of everything becoming relative and fast changing?

Andrew Sheng:
When you have big problems, focus on the big things first. It is not that you do not want to focus on detail. Indonesia is the fifth largest country in the world with a very young population, therefore, you must reach the take-off stage to benefit from the demographic dividend. Africa and the Middle

East also have a demographic dividend of many young people but there, the demographic dividend has become a deficit because these young people have no jobs. If Indonesia does not grow, the young people will not have jobs. Then you will have a big problem on your hands. Indonesia is very special because you are very blessed. You are living with the richest maritime resources and biodiversity. You have one of the richest cultures in the world due to many different languages, islands, cultures and so on. To conserve this for future generations is a monumental but very rewarding task. How you bridge the two is the biggest opportunity for Indonesia. I am very confident because Indonesia is about to take off. I would not be here if I were not confident about Indonesia. You must have confidence in yourself. Do not worry about structural problems, there will always be structural problems. Worry about the opportunity and how to grab it. That is the key.

Question 4:
My question is about picking technology. We have no more secrets and no more privacy. Almost everybody here follows the advanced technology, the digital hardware and everything. Behind that, however, what we have is owned by the technology. Five years from now, I think that a company from a developed country already know what they would do for us. This, I think, is a kind of trap for Indonesia. What is your opinion?

Andrew Sheng:
That is why I gave you this last suggestion. Take it back. Why are you giving this data for free? This data belongs to you. People do not understand that for everything they do, there is good and bad. How did China get into Tencent and Alibaba? It is because they did not want Google or Facebook. They are big enough so they can do that. Indonesia, like everyone else, has said that they do not mind but after you do not mind you have given away all your data for free. After seeing the America First policy, we are now saying that we want our data back for free. If Malaysia tried to argue this with Google, Google would say that the Malaysia market is too small so they do not need to pursue the issue further. Indonesia is the fifth largest market, however, so Indonesia is big enough to tell Google to give the data back for free. I am not against Google or Facebook or Tencent, I am just trying to be a little bit fairer. I only just recently learned that you can do this. I did not know that an individual could instruct Google to delete all of their personal information. You can also now do this with Facebook too. If an individual can do it, a country can also do it. That is why companies in Indonesia can use that data, otherwise how can you compete against the big company that is able to buy data from Facebook but you cannot buy such data. That is not a level playing field. You gave the data away for free so why do not you take it back?

Note: The powerpoint presentation material are available at website: ///https: [fill in]