Economics redefined by reality

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QUANTUM ECONOMICS

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INTRODUCTION

Quantum Economics is our shortest book yet. Hopefully it is correspondingly more meaningful. In a literary sense most, novels should not be written because they could be better short stories.

Without pretensions to achieving such literary status this condensed book tells this short story:

Quantum Physics has changed our knowledge of reality. Our perceptions struggle to reshape themselves. Quantum Physics proves that reality - past, present, and future - does not exist as we perceive it. The derived laws that govern social "sciences" are thus plain wrong.

This book applies this (just) to economics. It describes how and why traditional economics is structurally flawed, cannot predict, and provides comfort zones for mediocre thinking. In other words, traditional economics has little worth outside of being a historical databank.

This book also looks at what and how such failures will be corrected, which brings us to Quantum Computing…..

QUANTUM ECONOMICS

Why write this?

Reality is being redefined by science, not by culture, politics or religion. Quantum mechanics lies at the core of this process. It matters to economics in these ways:

- Economics relies on certainties that may be changed by quantum mechanics. Free will and rational behaviour are examples.
- The dismal science is in fact the backward science with reasoning that seems as dated as Newtonian classical mechanics.
- Basing models upon history, as economics nearly always does, is just sophisticated historical chartism and will not work well if my present is your past or if another course is determined by the particles within us!
- Human behaviour and consciousness may stem from chemical and quantum mechanical processes with different laws than those assumed in behavioural sciences.

All of this calls into question the certainties of our perceptions of, and the confidence we can have in, the systems we have constructed to manage our existence. Little escapes this judgement and certainly not economics.

Reasoning

Quantum mechanics, the replacement of Newton's classical mechanics, fascinates me. Not being intelligent enough to become a theoretical physicist, I enrolled as a "lay" student of quantum mechanics in a course that will at least give me some understanding of it and make me able to write simple stuff. I write about it not as a scientist but as a commentator, much like Dennis Potter seeing familiar reality irreversibly transformed in an NHS ward through the eyes of the Singing Detective.

Pooh-poohed by Einstein as spooky action at a distance, quantum mechanics proved him wrong. Or rather the Danish school of Bohr, Schroedinger (of cat fame), Heisenberg, and later the Northern Irish physicist, John Stewart Bell, did so and did so decisively1.

Before delving into what the Danish School (as it is known), proved, first let's see how quantum mechanics is different from other human creative endeavours. The human creativity invested in the theories of quantum mechanics is, I think greater than that in other human activity – including most forms of art. This is because the breadth of the vision that underlay, for example, Superpositioning, Entanglement, and Wave or Field theory was breath-taking as hypotheses and visions of the universe before they were proven scientifically true. And quantum mechanics is superior in that it is observed science; quantum theories only ultimately stand if they match scientific observations. In contrast, characters in a great novelist's work will stand whether they match the real world or not, as many of Dostoyevsky's, Austen's and Dicken's characters for example do not. Similarly in economics, the variables like R*, U*, G* that populate the policy landscape are not merely unproven but entirely unobservable. That is an inferior form of science if it is science at all.

We are also blissfully unaware of quantum mechanics because it has a reputation for being the science of little things and short distances, and we and we are reassured by the comfortable truths and existence of big things — like our furniture, spouses and the moon2. But this is wrong because the big things are made up of little things that are active in opposition to their comforting stability. We can sit on our chair, confident that it will not simultaneously be in two places at once; or transform itself into a flux. But the subatomic parts that make it up do just that.

The reason big things lend us stability, compared to the quantum mechanical world of small things, is because big things cannot be isolated informationally like small things3. One reason this is so, is that big things are too warm! The other reason is particles (protons) keep bouncing off big objects and atoms adhere to them. This reveals their path through time and space to the universe. And this in turn causes any wave or field function to collapse in decoherence4. Once a wave function collapses for one particle in a big object, all wave functions for that object collapse (Objective Collapse Theory).

Some of the laws of quantum physics

Superposition: a particle can be in two places at once. So, Schrodinger's cat in the box (which is a symbol for a subatomic particle not a real-life sized cat) can be both dead and alive and becomes only one outcome — dead OR alive — when the box is opened. The undefined wave function of particles is a Superposition of multiple probable locations. It collapses upon being measured.

Quantum coherence: is the ability of a particle to behave like a wave — undefined as a particle — moving in multiple pathways at once.
Particles: are waves before they are measured. Only then do they assume a defined object, form and location (the latter only being measurable within a given probability given its velocity and location — the Heisenberg principle of uncertainty).

Quantum tunnelling: A particle, say an electron, can pass in whole, or part, through an impenetrable (theoretical) wall or barrier between two chambers of a box and can achieve either superposition (being on both sides of the barrier) or just transposition (passing completely through the barrier without jumping over it. When a particle does so it exists as wave – or a range of probable locations and velocity.

Quantum entanglement: Entangled particles can communicate at something like the speed of light across time-space (Einstein's concept). An unsolved question is whether they can communicate forward as well as backward in time. Einstein thought any "matching" change in particles was pre-encoded into them. But the Danish school contested, and John Stewart Bell proved, that this was due to entanglement, not predetermination. In other words the particles are really communicating with each other. Einstein was wrong. degrees (west) while the other responds by shifting its axis to 90 degrees (east).

Quantum entanglement has now also been proven over long distances. Anton Zeilinger (University of Vienna) has experimented with entangled photons and demonstrated entanglement swapping or teleportation over 144 kilometres between two Canary Islands.

Decoherence happens when a particle is observed, meaning measured. It also occurs, as for bigger objects, when it is bombarded with other particles. Measurement ends both Entanglement and Superposition.

The sun heats us only due to Quantum tunnelling which makes possible the sun's nuclear fusion. The Quantum tunnelling process can be experimentally demonstrated by electrons (or other subatomic particles) passing through an impenetrable) barrier – either being completely transposed from one side to the other of the wall or being on both sides of the barrier at once.

Everything around us — big or small — is made of atoms. And atoms only exist because of the circulation of electrons which are quantumly entangled about the nucleus. If they weren't entangled, they would lose energy and fall into the nucleus, leading to the atom's collapse.

Put this way, the material world is like an inverted pyramid going from big to small but stands on the apex of what is small (the observed laws of quantum mechanics); a reality which more often than not operates in the opposite manner to all of our perceptions and reassuring certainties — like things being in two places at once, communicating with each other over distance and time, existing as waves of probabilities and tunnelling through impenetrable barriers. Therefore, quantum mechanics is not about the small or short distances. It is about everything. And the laws we assume about big things are as wrong as they are about the little ones.

A way to visualise this is to imagine objects being in multiple places (Superpositioning) at once, communicating with each other across the universe (Entanglement), a fuzzy reality (Quantum Coherence), where things behave like waves — and only become defined objects and achieve

locus once they are "observed" (which means measured by an instrument). Once they are observed, they lose their quantum magic in a process called "Decoherence". All this is proven science.

Stemming from it are concepts like Predeterminism in the universe that has pre-knowledge of quantum waves (and fields). How much faith would one place in the primitive plumbing of economic models running on the fuel of historical observations, if reality is fuzzy, predetermination rules the universe and one observer's present is another's past, future or parallel time?

Quantum mechanics changes our reality. And if our reality is swapped for another with different rules, even if we are far from fully understanding them, how trustworthy are any of our models based on the old reality? This goes for economics. But not only for economics!

Much of what is written above is observed science — not fantasy or science fiction, art or philosophy. It is for real. It was Bohm, author of the Pilot Wave theory that waves and particles are separate (now largely disproven), who said "if you're not confused by quantum mechanics, you have not understood it."

Being confused by quantum mechanics, not understanding it, has not stopped mankind putting it to use. Quantum mechanics' insights into electro-magnetics enabled the creation of the light bulb, the efficient transmission of data by the Bell corporation and the creation of semiconductors. These extraordinary leaps forward in technology were made with quantum physics but without understanding fully its mechanics. Only now, in developments like quantum computing, is a fuller understanding being brought to bear in the use of quantum physics to create products.

The creativity, thoroughness and scientific proofs of quantum mechanics make economics look at best a very inferior science. At best economics is a collection of hypotheses that are based on the statistical observation of the behaviour of the masses (sliced and diced in multiple manners).

And it is little comfort that policy is based on an increasing stock of asterisked variables which, even the learned academics admit are unobservable and can only be roughly estimated by historical measurement. When history alters course or doesn't exist, these efforts tell you little, for example, except what once happened, which is therefore assumed must happen again. An example today is the futile pursuit by policy of the chimeric goal of historical inflation. We may indeed get inflation back. But it will be "new" not historical! And the costs of "achieving" a chimeric goal may, in terms of the financial instability caused by money printing and leverage, far outweigh the benefits.

Worse is this! The very concept of economics is based upon a reality that is doubtful. It is the equivalent of assuming "big objects" exist independently, people behave rationally and that they are free to do so, and of course that quantum mechanics does not exist or does not matter when it comes to economic science.

What if this were wrong and people behaved more in accordance with how they are composed which is possibly, right down to their tiniest brain cell, quantum mechanical? What if quantum mechanics proves that the universe and everything in it is predetermined?5.

I am too weak a mind to take you there. But our economic comforts are starting to feel uncomfortable — a bit like a Newtonian apple's illustration of gravity in an Einsteinian framework of the curvature of space and time.

The traditional "particles" of economics are accounting identities. But economics is not accounting. It is, if anything, as explained above, the statistical description of mass behaviour. And it is not, with all its bland assumptions of free will and rationality, much about humanity either.

A few such economic accounting identities are that:

Exchange rates and interest rates are supposed to be a function of the current account (C/A). The C/A measures an economy's need for foreign capital, which is in turn the sum of the private and public savings deficit or surplus. A bigger C/A deficit should cause a weaker currency and higher interest rates. In this case the US dollar should be weak because the US has a massive savings deficit. But because the US is big and powerful it is seen as safe and enjoys the exorbitant privilege of printing the world's reserve money. So, the rule does not work.

The most famous identity is the Keynesian one that says savings (S) must equal investment (I) or the economy will not be in equilibrium. It will suffer either an inflationary demand gap (if I > S) or deflationary savings surplus (if S > I). So, the gap or surplus must be plugged by government spending (G) or taxing (T). If government spending is used to eliminate a deflationary savings surplus, this is assumed to create the sort of public investment that is perfectly substitutable for the private sector. Human behaviour does not allow this to happen. Public sector spending is rarely on a par with the efficiency of that of the private sector.

Once I thought all this economic dysfunctionalism was down to measurement problems. Now I think it is because people are wired otherwise and will never behave as they should if the economy is to reach equilibrium using such models.

What about the economic reality in a Covid or post-Covid world? History has, at least to some degree, been changed by the pandemic. There is a break, a lack of continuum, between what's to come and what was. Let us focus on one issue, create a framework and then smash it.

Covid destroyed work income. People, however, got richer. The government gave them more than they lost (even if, as in Europe and Japan, they remained at work but got paid by the state through their employers to produce little or nothing). They couldn't spend it all. So, household savings rates rocketed.

Think of it as a series of connected water tanks. The flow from work to households dried up. The flow from the state to households more than replaced it. The household income tank filled up faster than it emptied. Households spent of course. As they couldn't go to the shops, they spent online. But they couldn't spend as much that way. So, household savings went up to 20-25% of disposable income from say 3-7% (depending on the country).

Then, inevitably, the state largesse stops and household income starts to fall, unless the jobs market recovers enough to replace all the lost income and jobs destroyed by the pandemic. Even in the US this is not happening, with a net 10mn or so jobs still lost to the virus. Savings rates are now falling in most rich countries as households strive to maintain consumption. In the US, so far household savings rates have come down by about half from the pandemic peak — from 25-30% to 10-15% of disposable income.

Now the household fuel tanks are no longer full — or are not being refilled at the same rate. Unless jobs return to "normal" household income has no chance of returning to "normal" either. This means that, as savings fall back to minimal precautionary levels, consumption will gap down — everywhere, not just in the US. This happens as consumption is adjusted to lower post-Covid income levels. Then the supply-side recovery we have seen (more in manufacturing than services) will experience a demand gap. We call this the Potential Demand Deficit (PDD).

The PDD will need yet more policy intervention in terms of monetary and fiscal policy to keep economies chugging along. Given where we are starting from, this will ultimately raise issues of sovereign debt sustainability. Or will it?

So far this has been a pretty standard description of Keynesian-style water tanks and macro-economic plumbing. But it is unlikely to be right. The variables that will make it different are quantum economical — the unpredictable and unproven behaviour of individuals, which may nevertheless be sustainable — as well as the undefined relationships between variables like liquidity and income.

There are perhaps these outcomes (among many others):

Optimistically, in a world awash with liquidity, people may get access to cash in ways that are unprecedented. So PDD never happens.
Pessimistically, the awful inequality which Covid is engendering may mean we enter a revolutionary era suddenly.

In a middle scenario, perhaps central banks and government really do have the ability to incur infinite debts, print money and deliver (crypto) currency to the masses in a targeted manner. After all, it depends on what is credible and perhaps our spacetime path makes this predestined! The world heads towards a centrally-planned socialised economy which is in effect Marxism without the ideology and with much better technology to drive both some semblance of growth and the efficiency of policy.
I would bet on the latter. But with humility.

Footnotes

1. There are still many unresolved issues between Einstein's theory of General Relativity, as set out in his ten field equations, and quantum mechanics, not least the unreconciled difference between Einstein's curved space-time and quantum mechanics' flat space background across which the particle waves dance! But what we deal with here is what is proven scientifically in quantum mechanics: the nature of the matter that surrounds us and how it defies our perception of it.

2. Metaphysics questioned such complacency for centuries- but without the science to prove it. Take Bishop (George) Berkeley, the 18th Century Irish philosopher and worthy Church of Ireland Bishop of Cloyne. He was an opponent of John Locke's theory of mind and consciousness and of Isaac Newton's theory of absolute space, time and motion — known best as classical mechanics (Philosophiae naturalis principia mathematica — mathematical principles of natural philosophy). The good bishop had ideas that were precursors of quantum mechanics and of Einstein. In "An essay towards a new theory of vision", Bishop Berkeley argued that objects seen are not material objects but perceptions of colour and light (esse is percipi — to be is to be perceived). In other words, the moon exists because you see it; "nature or matter do not exit as a reality independent of consciousness" — much like a particle being defined by observation in quantum mechanics.

3. The reason big objects do not have easily measurable wavelengths is because wavelength shrinks with mass and becomes increasingly difficult or impossible to measure. The math underlying this depends on the work of De Broglie and Planck — both father figures of quantum mechanics.
De Broglie's wavelength = h (Planck's constant)/p (momentum) where momentum = mass times velocity. The bigger the mass (as in the case of big objects) the smaller the wavelength.

The Planck constant: E (energy) = h (Planck constant) * F (frequency). Or ...

The Planck constant multiplied by a photon's frequency is equal to a photon's energy.

4. Super Determinism, String Theory, Many Worlds (all as yet not scientifically proven) — contend that the universe is predetermined, and it is this predetermination that governs the behaviour of subatomic particles. John Stewart Bell, who proved that entanglement existed, tended towards this view. The Danish school (Bohr et al) believed that decoherence created freedom to define post entanglement reality. The scientific jury is still out!

5. The idea of free will, or lack of it, is likely to be decided by science, not theologians. Quantum Mechanics, Entanglement, Coherence and Decoherence are all compatible with free will if, as the Bohr school leaves open, decoherence creates freedom for the determination of future pathways. But under other theories, like Super Determinism, Pilot Wave or Bohmian Mechanics, the universe is programmed down to the smallest detail and so are we. This raises the possibility the decoherence has nothing to do with wave collapse and measurement but due to the observer becoming part of slice of "present" time and space which is either past or future for other observers. The wave would continue to exist in these other dimensions.

6. A key additional question is whether human consciousness is quantum mechanical. If it is and quantum mechanics is predetermined or not than human consciousness would be too. Most research says the human brain is too hot and sticky to support particle entanglement, contrary to the theory of Sir Roger Penrose (Entanglement of Tubulins). But there are other cerebral nuclei that appear to operate somewhat like entangled particles and could allow for a longer (1 second) period of entanglement before decoherence sets in. This is about the minimum period of time to allow the brain to function and for consciousness to be the result of entanglement. The kernel issue is whether superposition would last long enough to allow the brain to function in a quantum mechanical manner.

THE TRUTH TO TELL

A short while ago Quantum Economics was written (15 December 2020). It sparked numerous conversations and comments from clients, commentators and even some friends.

A recurring theme was: "You make a case that our predictive econometric and market models cannot work. But with what can Quantum Economics replace them?" The answer is with a better, less structured way of thinking, albeit not with anything like the rigorous science that underpins quantum entanglement, transposition or tunnelling! After all, we still lack a quantum theory of gravity (to reconcile Einstein's spacetime with the scientifically-proven but wonky world of quantum wave theory). String or loop theories may ultimately point the way to a quantum theory of gravity that may modify Einstein's spacetime or replace it. But we are not there yet. Consequently, it would be a bit premature to expect coherent quantum market or economic models. But quantum thinking can still add value.

To hark back to Chapter 1, it showed that the underlying reality of the universe is being rewritten by science. More often than not this is in ways that are so contrary to our perception that it is hard for the human brain to envisage1. For example, objects being in multiple places at the same time as in wave theory and a multivariate universe; even Einstein's spacetime and gravity can be expressed mathematically and proven scientifically but can be imagined only with difficulty by our three-dimensional brains. The big objects of our "stable" universe appear stable because they are big and warm. But they are composed of the quarks and other fundamental particles of the quantum world. Thus, below the surface of seeming stability they are in flux in a quantum reality.

From the time we were hunter gatherers chucking spears at beasties to discovering continents with compasses and developing Euclidean geometry, we have encoded 'big objects' into our mental chips.

This comfortable cosmic order is now being torn apart. But we can still picture little else.

This quantum reality raises issues such as the possible predeterminism of everything in the universe — and thus the existence of rationality and free will. It raises issues of time (whether my time is someone else's future or past); parallel realities and communication across spacetime (towards the future and the past) and between particles at speeds that are possibly multiples of the speed of light. These are quantum questions. The answers are unscientifically proven as yet. But the questions being posed will have to be answered. And when they are, the script of our reality will be rewritten further.

We cannot transpose the science or mathematics of quantum theory to economics. At least not yet. But we can apply the logic of what quantum theory implies.

Start by asking the question: why are our predictive models incapable of predicting any shock of any importance? By this we do not mean the minutiae of the next Fed move. What is meant is that the models do not predict major events. And when they occasionally do, they promptly stop working. The Wall Street crash, the various sovereign debt crises, the global financial crisis and Covid's economic consequences went virtually undetected until they were already well underway.

Take the global financial crisis and the Eurozone debt crisis. These were deemed to be caused by excessive leverage. One might argue that the BIS provided an explanation of them. It was that if debt rose by X% faster than GDP for Y years a crisis would ensue. Yet massively increased leverage has been the cure used to address these recessions and ensuing crises like Covid-19. So far leverage has been a saviour, not a curse. So, the model is wrong. Or it was right and died because it was (just as decoherence — or the end of quantum magic — sets in once entangled particles are observed or measured) the economic version of a quantum version of Goodhart's law.

Our economic models are based on the outdated perception of a stable universe of big solid objects. I am reminded of a play I once saw in which an aristocratic mistress said to her maid who wished to quit: "But I am most fond of you!" and the maid replied: "Yes madam, as you are of that chair, because you know it is always there for you". If our very brains are made of quantum molecules and subatomic particles obeying quite different laws to the chair, which they also constitute, then the surety of our perceived reality is an illusion.

Our models are based on historical equations and data. This is flawed in two ways. History is no guide in terms of data or relationships to the future. All crises imply a discontinuity with the past, or they wouldn't be a surprise and crises normally are! But worse the "proven" historical correlations that are the bedrock of predictive models, may be specious and merely coincidental. Traders have long known this; adaptability goes hand in hand with longevity, the more rigid can do well for a time (even a long time) then find their seemingly successful knack (and career) is suddenly over. Some even are forced into becoming strategists!

Chapter 1 analysed some key economic relationships that we lean on, but which are clearly fiction in the context of both quantum thinking and the observed workings of economies.

Let us apply some of this to the way we think about our investments and expectations.

Consensus is that equity markets will go on rising and interest rates will stay near zero because there will be no inflation. So central banks will be able to go on financing governments which, in turn, will go on spending to plug the Covid-scarring that afflicts the economy. And, of course, vaccines will create Covid herd immunity in six months. So, optimism abounds, demand booms and financial markets in the main go on rejoicing.

That might be doubtful, but it is the current consensus. And it may describe the early part of the year, but not thereafter. Let us replace such coherent consensus with some creative "quantum" incoherence.

Equities

Central bank (CB) funded sovereign debt is the fuel in the tank of the global equity market boom. CBs and Ministries of Finance are now the front and back doors of the same building. Consensus is that this is fine, and will continue to be so, because GDP growth is scarred by Covid. So output gaps remain large and this ensures that there is no return of inflation.

But output gaps are a dicey predictive tool. As an ECB Board Member once said to me: "Output gaps are the greatest fiction in economics. As a historical series they are more volatile than GDP growth itself. They are therefore unmeasurable and useless".

Inflation can return because of other factors: big and inefficient post-Covid government; zombie corporations feeding low productivity; the ongoing reversal of globalisation; a return to nationalist economic models; or food inflation, due perhaps to climate change. Food, after all, makes up 40% of EM inflation. And prices of major agricultural commodities have been booming for six months or more.

Covid-19

Death is the great leveller. Covid is the great un-equaliser. Inequality and polarisation are the root causes of populism. Covid increases both. Polarisation and inequality are expanded by the pandemic both within societies (skilled versus unskilled workers) and between rich and poor countries (the former being able to work from home and the latter lacking in connectivity and often electricity). Liberal capitalism is discredited as inequality grows in tandem with the billions of the billionaires. Populism will return before the end of the year. Support for traditional parties which occurred during the pandemic, was due to those parties' better crisis management. That will not last.

Italy is the European fall guy. Among EMs, Brazil is another. It faces an impossible fiscal cliff. And it is ruled by incompetents. Short its sovereign debt and the real.

China

A Biden administration does not mean a reset of the US's hawkish China policy. China will not compromise on human rights or its state-dominated economy — see the Tencent, Alibaba story for proof. This is not the story of regulatory advance being pedalled. It is a power grab by the CCP to rein in the power of private wealth, which ultimately undermines the power of the Party. It is also something the rich West will have to do too if democracy is to survive the demise of unbridled liberal capitalism.

Failure to more than cosmetically recast US-China relations means globalisation will stay in reverse gear. China becomes isolated from the "West". It cannot produce, or get from others, the technology it needs to achieve its goals in four key domains: political control, boosting productivity in an ageing society, meeting its consumers' online expectations and military might. As an example, China cannot make 5 nanometer (nm) silicon chips it needs for a 5G economy. The best SMIC — its most advanced chip producer — can manufacture are slower and less efficient 14nm processors. It will take five to ten years for China to bridge the gap.

The happy consensus belief of sustained 6% growth in China's GDP, and the anticipation that China will overtake the US in terms of the size of its economy in just a few years, ignores China's falling total factor productivity, its excessive leverage (300% of GDP and rising) and the malinvestment its local government and SOE-driven credit binge creates. All will tax growth.

A slowdown is the story of 2021 after the "normalisation" of 2020. And the growth that is generated will continue to be unevenly distributed. Covid has sharply worsened an already bad distribution of both wealth and income in China, as it has elsewhere.

It is likely that President Xi Jinping will become internally contested within the Party starting in 2021. And this matters in the year when Xi will try to prolong his reign. One outcome is that Xi is likely to use external military projection to distract from his domestic and international failures. Taiwan is in the crosshairs.

Global trade and EMs will be the victims. The Chinese renminbi will be stable until the end of the second quarter but thereafter these risks will come to bear. We expect it to fall 10% on a TWI basis in H2.

The US as a polarised society

Biden cannot address the polarisation, inequality and increasing violence of US society. He has to start in the wrong place both fiscally and in terms of political trust. Equities may grind higher for a while, but the bull market is not sustainable much longer.

The US dollar's decline will continue for three reasons. The dollar is a low-cost funding currency. People are replacing fiat currencies, but particularly the US dollar, with alternatives (such as digital currencies, gold and commodities). And behind this is the grinding trend to replace the US dollar as global reserve currency.

Brexit

Trade deals bring parties together. Brexit moves them apart. Sovereignty (as per the UK's narrow definition that motivated Brexit) and economic efficiency are negatively correlated. The UK has lost access to the single market which accounts for 40% of its exports. Services are not even covered by the deal struck before Christmas. And the UK is a service economy. The big loser is Ireland. Sterling will fall after the initial rejoicing. We are short the pound vs the Norwegian krone.

Investment strategy

Not all of these predictions will happen. They are not seamlessly stitched together like the consensus view, where every causal part is linked. If quantum thinking changes one thing for strategy, it is the lesson never to think like that — in terms of a seamless coherent universe. Because there isn't one out there. Some of these shocks will happen. Enough perhaps to disrupt markets partly or completely. And certainly, these will provide reason to dedicate a part of portfolios to their occurrence.

We remain long equities for now, but we are wary! Commodities look better; we remain long copper and gold and would be long wheat. Bonds are a value trap. In the Eurozone we would look to short Italy. But we are neutral on the others. Ditto the euro. We remain long alternative currencies (Bitcoin and Etherium).

Footnote

1. Due to the inability of our minds to visualise the realities of proven physics like spacetime or wave theory, the heavy lifting creative work of redefining our reality is being done by maths and physics — not by visual art or literature. One might speculate that perhaps ultimately Sci-Fi writing could become an art form rather than a cultish entertainment, just as John le Carré transformed the spy novel! Carl Sagan's novel "Contact " (1985) is an example of the use of some serious scientific thinking being put to work in fiction (the use of "wormholes" to travel in time).

MY PERSON FROM PORLOCK

You may remember that a person from Porlock interrupted Coleridge's composition of the oneiric poem Kubla Khan. So, it was never finished. The poem was probably drug-induced to begin with and has always struck me as one of those works of literature we accept as great because we are told they are so.

My person from Porlock is a very good friend who I cannot name because he works for a particularly big bank. He interrupted my quantum musings, which were probably smug but not, I stress, drug induced. On the contrary, quantum economics (QE) is a mirror held up to the scientifically proven bits of quantum physics. QE seeks to inject into how we think about our investment trade, the rubbery reality of the quantum world, which contradicts so much of our perception of existence. Why, it asks, do we assume that how we think about both the future and past should follow a different logic to how, below the comfortable sureties of big objects, we and the universe are composed?

But to be practical, the asset forecasts that we derived in Truth to Tell were not coherent in a traditional economic framework. That consensus framework is that central banks and governments will go on printing money and holding the cost of capital at zero or below. That liquidity will continue to boost markets and suffer no marginal decline in its ability to do so (a mighty assumption!). And vaccines will produce Covid herd immunity by the end of the summer. The end of pandemic angst and misery will unleash pent-up demand from confined households, which will draw from their unneeded precautionary savings and binge.

So, bonds have little risk (even if they have little upside in store). The US dollar will trend weaker. This because the US will increase supply of its currency more than anywhere else. And, in a risk-on world, the US dollar will be the funding currency of choice to buy higher-yielding assets than US Now this forecast is seamlessly embroidered into a patchwork quilt of coherence. In terms of traditional economics, each part connects logically to another.

Then along we come, in the immortal words of Dr Fauci, like the skunk at the picnic, with our forecasts of disappointing global growth and the start of stagflation as a natural part of the post-Covid economy, set by big government, zombie corporations, deglobalisation and a return to nationalist economics. There will be a tepid expansion of global trade and the recovery in EMs will be weak. The euro might be stronger in the short-term, but rising US and global bond yields will ultimately weigh on that. And, I nearly forgot, a 10% devaluation of the Chinese renminbi versus the US dollar by year end.

My friend from Porlock is not at all convinced of the consensus forecast. Being intelligent and of long experience managing money — very cleverly I might add — he knows right well that the outlook subscribed to by every big bank on the planet will be wrong.

But he also took issue with the incoherence of our forecasts. If growth is to be poor, why will inflation return and why should US yields rise? How, if US yields rise, will the US dollar resume its long-term declining trend? In a world where the US dollar is weak, how can the renminbi also be weak? Why would commodity prices rise in a world traveling towards stagflation? And why will the high-spending governments and central banks of the world not go on pumping equity markets and keeping bond markets quiescent?

He is of course quite right. Our forecasts are incoherent. Under the QE way of thinking, each module (call them sub-atomic particles) obeys its own coherent logic, but the patchwork of all the particles does not conform to a common logic. That this is right when it comes to forecasting economic outcomes and asset returns is clear from looking at the nature and causes of crises. The histories of crises are based on their own partial logic, or they would not be surprises to the coherent whole of the prevailing consensus at the pre-crisis moment in time.

To dissect this further ...

Inflation returns because big government needs to generate it to deal with the unsustainable debt burdens it has incurred and the populism that threatens its existence. Among other pro-inflation policies this induces is a return to nationalist rather than globalised economics. Let us not forget that it was predominantly globalisation that kept manufactured goods prices down for 20 years.

Inflation will also be created by governments because they will have to hold at bay the potential backlash against the increasing inequalities powered by Covid. They'll do this with handouts to the disadvantaged from their magic money trees. This boosts household income without a corresponding increase in output.

Inflation logically should not recur because macroeconomic output gaps remain large under our growth forecasts. And there are numerous structural forces weighing on prices, long discussed by the secular stagnationists. But inflation does return because it obeys a different and consistent internal logic, which makes scant reference to central bank money printing.

If US yields are rising why should the US dollar be weak? Higher yields should attract more money to the US. The answer is because people will flee fiat currencies towards cryptocurrencies and hard assets, to escape the corrupted synapse of central banks and their ministries of finance masters. This will happen first in the US. But there is another reason. The cold war with China will hasten the replacement of the US dollar as a global reserve and transaction currency. This is internally quite logical. But it does not match the macro framework we describe.

The Chinese renminbi can be made weaker than the US dollar even if the dollar is weak itself because once it is clear to China that its isolation will continue under the Biden administration, China will have little reason to to forego currency weakness.

A weak renminbi would offset some of the 'dual circulation' losses of being knocked out of much world trade growth and technology flows. This again is politically consistent. But it does not rhyme with the macroeconomics.
Commodity prices for food will rise because of fundamental supply and demand imbalances. These are in no small part due to the damage we are doing to our planet. But it is also because the politics of addressing that damage in the form of climate change will reduce the allocation of new land for agriculture. Meanwhile, globally, mouths to feed will continue to grow faster than the supply of food to do so. This is a fundamental supply and demand argument almost, but not quite completely, divorced from central bank-induced inflation of assets.

So, the logic of QE is logic indeed. Each modular forecast complies with its own logic. But added to together they are not consistent with the global macro picture dictated by our traditional economic precepts any more than quantum mechanics is consistent with Newtonian classic mechanics.

IT'S NOT WHAT YOU THINK BUT HOW YOU THINK IT

There is no difference between the creativity of scientists and artists. The creativity of scientists is verified, or not, by observation and experiment. The creativity of artists is tested against reality, perception and history. Artists include of course all creative arts — written, visual and musical. Think of Picasso's Guernica and War — not just the Spanish Civil War, but the scoping of all war to treat civilians as a strategic asset to be destroyed en masse. Strategists, when they are not just trading desk and momentum mouth pieces, are artists. Economists think they are scientists. But they can only prove their theories against history. That makes them nothing.

This final chapter on Quantum Economics summarises the most relevant bits of quantum theory and applies the thought structure inherent in quantum mechanics in a parallel way to macro forecasting of any societal variable — though I shall focus on financial markets as an example. What is sketched out is a quantum pattern of thinking but not a quantum model, as the observation and maths to do that are not there yet. But they will be.

The logic of this chapter is that if quantum physics has proven that the subatomic world behaves in a certain way, and we and the big objects of our perceived universe are made up of subatomic particles, then our macro world will reflect the quantum world. And, by the by, most of our social "sciences" are not sciences at all and cannot predict.

Poets and philosophers have long questioned how we deal with time, reality and space.

"We are too much like oysters, observing the sun through water and thinking that thick water the thinnest of air."
Moby Dick, Herman Melville

"Time present and time past are both perhaps present in time future, and time future contained in time past."

Burnt Norton — The Four Quartets, T.S. Eliot

But quantum mechanics proved what literature already claimed. The sub-atomic world of which our reality is made up obeys laws that contradict many of our perceptions.

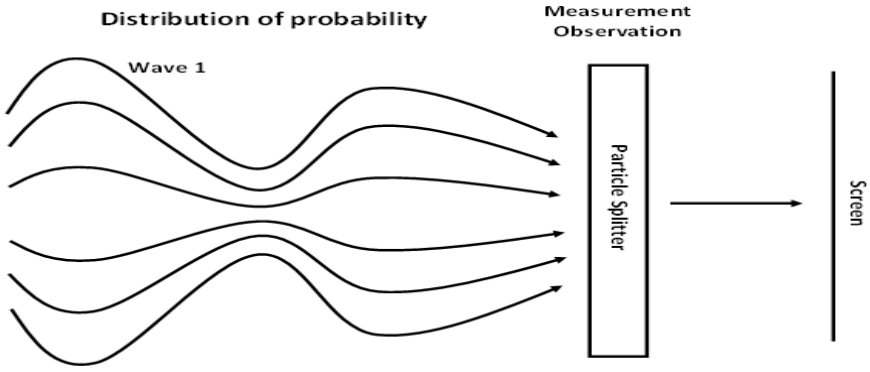
To summarise, for our purposes, a few essential bits of quantum physics, let us take particles, which:

- Can be in multiple places at once (superposition, decoherence and wave theory);

- Can be linked across space time and communicate with each other at something like the speed of light (entanglement).

This much is proven scientifically by observation.

Take wave theory: a particle, to the left of observation and passing through the splitter (to the single value of decoherence), can be in multiple positions at the same time. So the particle can be positioned simultaneously anywhere on any of the waves in Figure 1. This is not either 'here or there' probability theory. It is simultaneous multiple positioning.



Our interpretation of the world is based on the logic of big objects, things like kitchen chairs, cars, houses, trees, tables, spouses. These are BIG! They have big mass and slow velocity and they are warm. So they cannot be observed like particles. In a nutshell, big objects' wave function is unobservable. But they are made up of quantum particles. An example is the sun. It is big enough. But it would not continue to heat us for long but for quantum tunnelling (particles passing through and existing on both sides of a barrier simultaneously). This permits hydrogen fusion whereby huge energy is released as heat without diminishing the sun's mass. If that were not the case the sun would have shrivelled and shrunk to become a blackhole millions of years ago and we would have frozen.

Traditional forecasting

All of our interpretations and forecasting tools are based upon the seeming stability and predictability of big objects. An example is Euclidean geometry. Take an isosceles triangle. We all know, or have perhaps forgotten, that its internal angles make up 180 degrees. And that is has two sides of equal length. But that is not true if an isosceles triangle is drawn in Einstein's curved space time. So a basic building block of our perception of reality (and school curriculums) is simply wrong.

We do not know how to reason outside the comfort zone of big objects or even picture multiple dimensions beyond three! But big objects are not as stable as we perceive them to be because they are made up of particles obeying quantum rules. This human "deficit of perception" applies very well to our ideas about the forecasting future as a function of history. Almost all our forecasting tools are based on history. But the future is not a continuum of history.

Take climate change, all the model predictions (dire though they may be) assume that there are historical correlations between greenhouse gases and temperature. But what is missing is that there are probably cumulative relationships at work that can cause a sudden flip in climate conditions and catastrophic events outside what any historical relationship can capture.

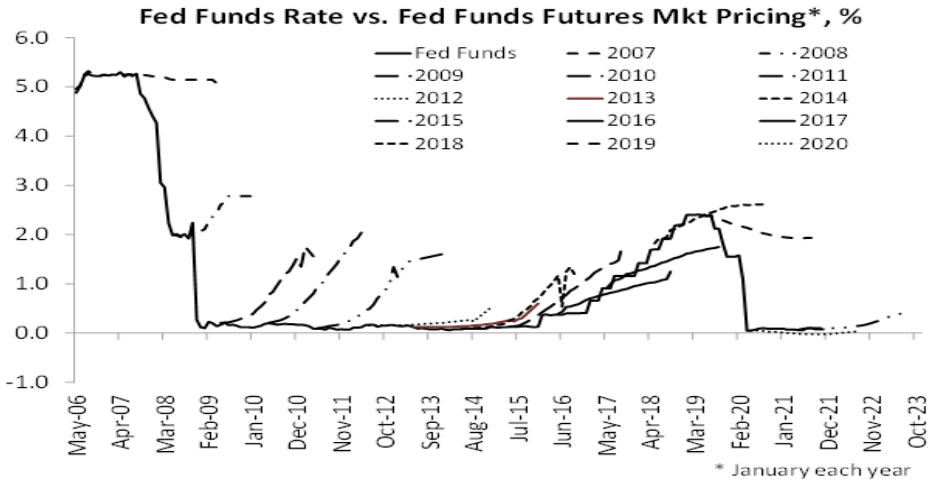
Applying the fuzzy magic of quantum physics to a forecasting world, here are some examples of how this does not work.

Take the rule of big committees; the collective intelligence making a forecast does not increase with the sum of the people involved but the sum divided by the square root of the number of people. So there is ensured convergence towards mediocrity.

Consensus forecasts never forecast a crisis accurately. Crises always happen as surprises. By definition consensus forecasts cannot surprise because they are shared and agreed.

In fact consensus forecasts do not predict standard market variables either.

Figure 2 shows the market forecasts for the Fed Funds interest rate. Literally thousands if not tens of thousands of people earn their living making these forecasts. They are almost never right. Indeed, the only time the forecasts are vaguely right, is when there is an established momentum, which the forecasts extrapolate.



The fallacy of using history to forecast is shown in Figure 3. A forecaster standing in 1914, using historical data to predict how fast man would be able to move today, would come up with a prediction between the dotted lines. Instead, we have reached point 'Now'.

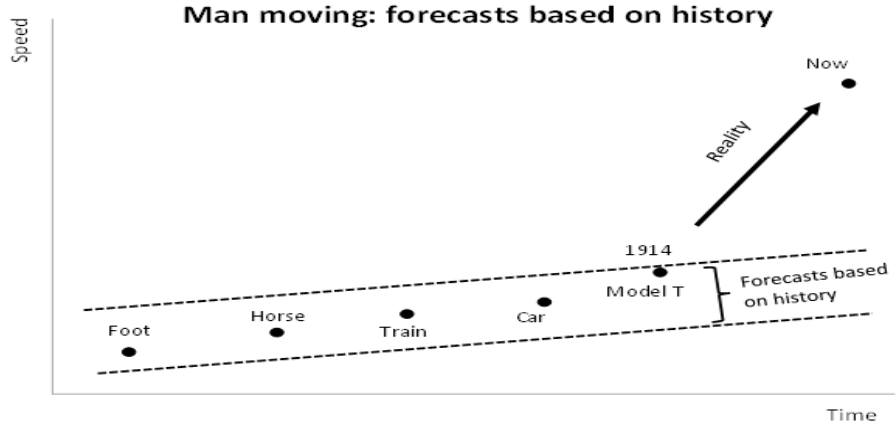


Figure 3.

It is not that economists are unaware of the uselessness of their methods. It is just that they are not willing to admit the limitations of their methodology or the consequences of these errors.

Three examples illustrate this:

NBER

"In reality, however, the distribution of shocks hitting the economy is more complex ... might exhibit excess kurtosis, commonly referred to as "tail risk" in which the probability of relatively large disturbances is higher than would be implied by a Gaussian distribution." Mishkin, F. S. (2011): Monetary Policy Strategy: Lessons from the Crisis, Working Paper 16755, National Bureau of Economic Research.

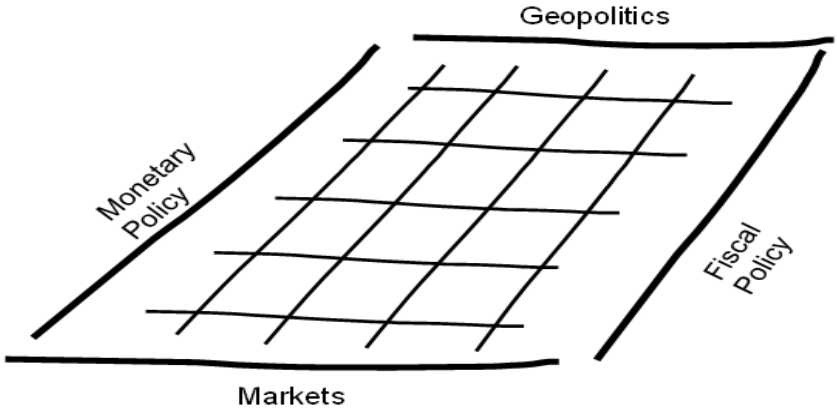
ECB

"We analyse the impact of COVID-19 observations on two widely employed time series models, with a focus on euro area inflation. We investigate single equation models (Phillips curves) and Vector Autoregressions (VARs). We show that in both cases the parameter es timates change notably after adding the COVID-19 observations to the estimation sample, which also affects the forecast path." ECB Elena Bobeica, Benny Hartwig: Working Paper Series No 2558: (May 2021) The COVID-19 shock and challenges for time series models.

US Fed — Jackson Hole papers

Jackson Hole: all academic papers are based 100% on historical correlation of observed variables. But the history of variables does not explain the future.

Think of our traditional forecasting as a rectangular consensus quilt of macro forecasts with four major variables at the edges (Figure 4).



The major dependent variables, each representing one side of the quilt, are fiscal policy, monetary policy and geopolitics. They determine the remaining side of the quilt: the dependent variable of markets.

The patchwork, like Paul Klee's Magic Squares, is made up of independent variables or disruptive events that are related to each other by historical correlations and to major variables at the edges of the quilt.

All crises are surprises that result in internal decoherence stemming from a few cells disrupting the logic of the quilt (Figure 5). The cells are consistent with themselves, but not with each other.

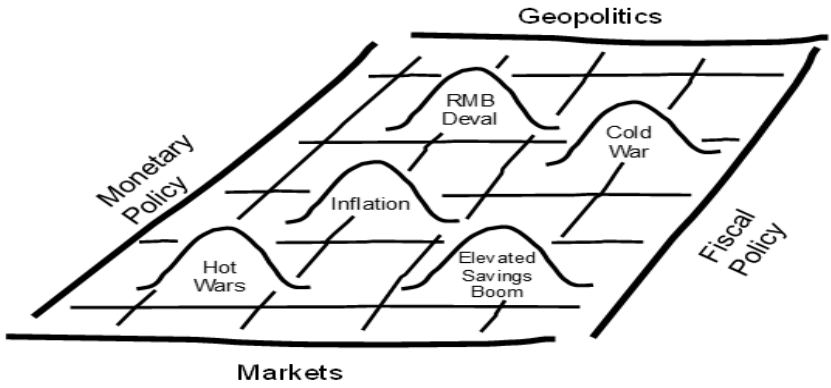


Figure 5.

It is not hard to create an asset allocation system that in "thought process" mirrors this. But it cannot master the complexity of thousands or millions of variables that mirror human behaviour of which economics is merely the statistical record. Enter quantum computing...

That will change within a few years with quantum computing (QC). QC will allow computation of the quilt's internal cells (in all their millions, billions and trillions) and their disruption as the source of forecasts. This process will not be based on a historical correlation of observations but upon the future feasible values of the cells.

The rupturing of Moore's law

In simple terms, Moore's law (Figure 6) states the number of transistors on a silicon wafer doubles every two years. This law has been breaking down due to the physical limits of materials science but also because of the long lead times and capital costs of producing sub 5nm semi-conductors on an industrial scale. What QC does is to expend the capacity and speed of computing as an alternative to Moore's law, but not at all because of it.

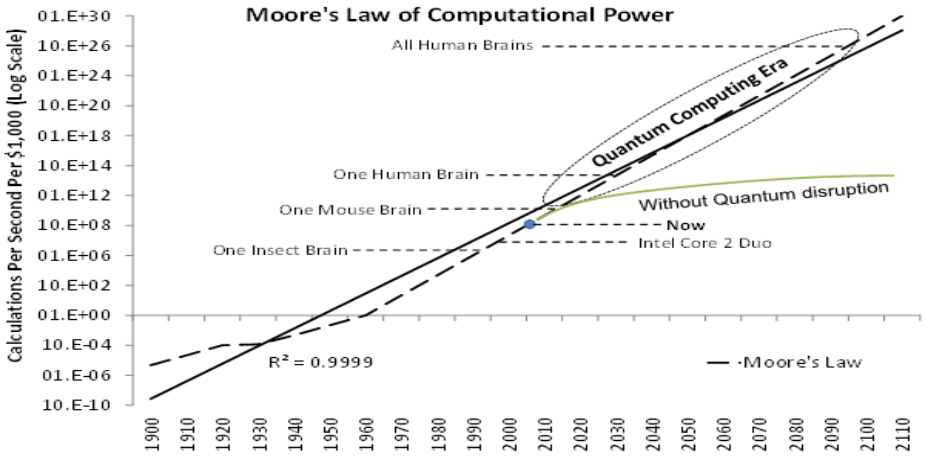


Figure 6

How quantum computing matches reality in ways that classic computing and forecasting cannot:

1. Quantum computing is quantum physics. It thus represents reality in a way that classic computing cannot.

2. QC works by super positioning (multiple simultaneous positioning (as in wave theory)) of qubits; and

3. Entanglement (spooky action at a distance).

4. QC can thus behave randomly while being in a definite physical state.

5. In classic computing Bits are either 0 or 1. In QC they are both.

6. In binary logic, things "are" or "are not". QC doesn't impose that limitation. Things are both.

7. Qubits only assume defined "classical" value after they are measured.

To illustrate all this think of a maze! The Hampton Court maze might be a good example. But the maze of a computer game is just as good and perhaps more to the point. A classical computer will try to solve the conundrum of how to get through the maze and out the other side by sequencing every path. Try one. Then the other. When it finds one successful way through it will go on trying until all the options are exhausted. A QC will try all paths simultaneously. That is why QC's offer such big advantage in terms of capacity and speed.

In sum, quantum computing offers the speed and capacity to deal with (1) the complexity and realism of inputs; (2) simultaneous computation of all pathways, which classic computing cannot do.

What data will be used then to make forecasts? There are two open (and undecided) roads. The first is that hugely more historical data can be used as an input to QC models. So instead of forecasting inflation as a function of supply-side disruptions in a few sectors and countries, data from a mass of new sources which are currently "siloed" can be integrated into the QC predictive model. Current computers are too slow and their capacity too limited to be used for this.

But we do not believe that more data will be the nirvana of forecasting, though it could well reduce errors. There is another route. Take the development of MRNA vaccines! The speed at which they were developed and approved depended on mass testing of their effects using stored DNA and other data. This is not about predicting the vaccines' effect on a historical series but on the actual make-up of human beings.

It is more likely, if very hard to define today, that actual and predicted, rather than historical data, will become the raw material of forecasting. An example is the use of neurological models that predict human behaviour.
QC being "reality" will compute "reality" incomparably better than any classical method.

A caveat: a QC today looks like the laboratory where Frankenstein's monster was created (Figure 7). It has to operate at close to zero real temperature and is disrupted by noise. Clearly a QC is not a laptop. In fact, the cloud is the only means of transporting QC capabilities into most forecasting ecosystems.

Figure 7

Figure 8 shows a QC configuration which approximates how it will work for the immediate future: classic computing is the gateway.

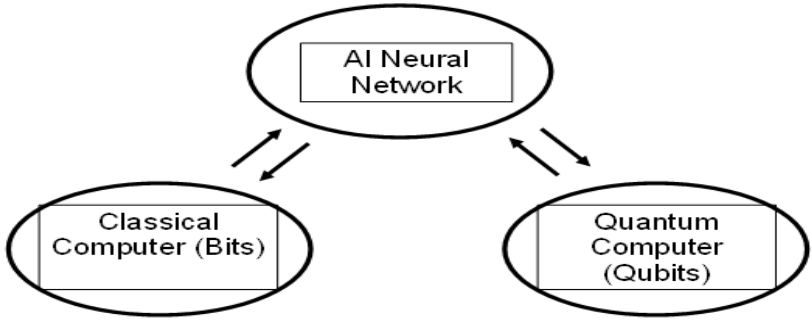


Figure 8

• Neural networks act as the intelligent cloud storage of data and feed to QC and classic computers

• The "computing" is done by quantum computers

• Quantum input and output will continue to be classical

• Quantum constructive and destructive interference to select outputs. (Shor's and Grover's algorithms can also be used).

Disruptive variables

Now let's turn to disruptive variables. This is not a stitch-up of variables in a nice harmonious forecast but a contradictory list of disruptive variables. There are only seven variables ut they can be assembled in 127 combinations.

1. Kabul's significance is to reveal the flaws of the Biden administration. These will compound to increase the risk to Democrats in mid-term and Presidential elections. The ultimate outcome makes it quite probable that Biden will be a one-term President and Trump (or a Trump puppet) returns

to office. The consequences would be heightened risk of war with China, international trade wars, isolationism and a rapid breakdown of world order; deglobalisation — near-shoring of production to reduce risk not increase efficiency — geopolitical and economic isolationism.

3. China – the primacy of ideology over economics — the new cold war, Taiwan, the inevitability of a cross-straits war.

4. Positive loops and environmental surprises — newly-competitive renewables may do what politicians cannot — mitigate climate change.

5. Pandemic and undeveloped countries — the permanency of pandemic.

6. Crypto assets and the replacement of fiat currencies to escape big bother government.

7. War and economics — the commoditisation of hi-tech war and the incapability of rich countries' defences against cyberwar.

The most likely combined outcome is this: big government, nationalist economics, deglobalisation and a fiscal and monetary marriage made in hell. Ultimately this edifice will either collapse under its own weight or result in a low growth, low productivity, high inflation economy.

If it is the latter, the Sovietisation of the economy will be mirrored by the Sovietisation of state control over individuals.

If collapse is the outcome, power will be transferred back to the streets but in a form unlikely to be compatible with democracy. On both counts Hayek was right!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