MACHINES LEARN, BUT FIRST THEY HAVE TO BE TAUGHT TO LEARN.

The world and our brains are analogue, computers are binary. Analogue is infinitely more complex than binary, which cannot be emulated by binary systems including the qubits found in so called quantum computers. Binary systems, because they do not spontaneously form imprints of the external world, need programming. This programming can only be undertaken in the first instance by humans with all their fallibilities.

The purpose of this article is to begin examining the role played by computer algorithms in assisting and even replacing financial and investment decision making. It was inspired by the lead article in the *Economist Magazine* (5th – 11th October 2019) titled *Masters of the Universe*. It poses the question, as to whether these algorithms are leading or misleading investors, and, whether they will be blamed for either delaying or precipitating the inevitable crash of financial markets.

To better understand the limitations of converting what is an analogue world into a digitally represented world, there can be no better vehicle than the difference between vinyl records and CDs (or latterly streaming). Vinyl records are analogue. Their accuracy in terms of mechanically duplicating music as it emerges, depends on the quality of the microphone which captures the sound, the recording equipment, the durability and quality of the medium on which it is imprinted, and the quality of the equipment which reproduces the sound. It is possible, using a non-PVC resin to produce a medium which is more durable, and which more faithfully imprints the sound. But that is by and by. Music lovers tend to favour vinyl or analogue music because it is "warmer".

The reason for this is that the conversion of analogue into digital, requires sampling. This process is called ADC and it involves quantization, in this case, an industry limit of 44,000 samples per second is used in which analogue sound is broken down into digital bytes. Thus the ADC cannot hope to produce a perfect imprint because this is mathematically too complex. This necessarily results in what is called "jaggedness". For example under a strong magnifying class, digital smartphone pictures resolve into individual pixels whereas a microscope's view of a slide will reveal smaller and smaller details until its limits are reached.

Thus what algorithms do, is to sample the outside world or more often, data streams. Algorithms may be presented as the future "eye of god", but they are not, nor will they ever be. The world is far too complex and fluid for that. Rather they are focused mathematics constructed by human's for inquiring into desired traits and connections. Where algorithms have been given more or less free rein, they invariably return with misleading results, which are only discovered after much time and effort has been wasted by human researchers on verifying their results.

Furthermore, algorithms do not have a life of their own. They are not immaculately conceived. They embody the limitations, prejudices and biases of their programmers. Their tunnel or skewed digital vision is not accidental, they are the product of the recognised or unrecognised, chauvinism, racism, religiosity, nationalism of their programmers. Nowhere is this truer than in the realm of financial algorithms, where programmers with their "vulgar economics" and false assumptions, blind algorithms.

The blind leading the blind.

The two articles in the *Economist* reveal that machines are taking over investment decisions especially in US Stock markets which are valued at $31 trillion, a fabulous sum. *"Funds that are run by computers that follow rules set by humans account for 35% of America's stockmarket, 60% of institutional equity*

assets and 60% of trading activity" (My emphasis.) And again: *Exchange-traded funds (ETFs) and mutual funds which automatically track indices…had $4.3 trillion invested…exceeding the sums actively traded by humans for the first time."* Finally: *"Three years ago quant funds became the largest source of institutional trading volume…They account for 36% of institutional volume so far this year…"* Quant funds are interesting, because they more than any, base decisions on quantitative sampling.

The *Economist* is of the view that all this computerisation has improved the efficiency of the market because it has lowered transaction costs and the speed of the transaction together with the delivery of the instrument being traded. But the purpose of the market is not efficiency, it is discovery. As the *Economist* says in its opening sentence: "*The job of capital markets is to process information so that savings flow to the best projects and firms."* In the words of Marxists, the job of investment (credit) markets is to direct investment from industries and firms with below average rates of profit to firms and industries with above average rates of profit.

This seems very simple. How difficult is it to write such an algorithm? Extremely difficult because it is chaotic, and impossible, unless it is guided by a theory of capitalism that is real and evolving. The *Economist* gives a nod in that direction. It quotes Bryan Kelly of Yale University who investigated the efficacy of purely machine derived factors which in the end turned out to be spurious. "*He says combining machine learning with economic theory works better.*" So it is economic theory that converts machine learning from yielding spurious results into one that yields "profitable" results.

The reason for this is that economic theory concerns itself with **how** the economy works, and until you have worked out the **how** you cannot know the **what** to look for. As the *Economist* quotes elsewhere: *"If you apply an algorithm to too large a dataset often it reverts to a very simple strategy, like 'momentum'".* And "*A machine learning strategy that does not employ human logic is bound to blow up eventually if it is not accompanied by deep understanding"*. The problem with programmers, even ones led by bourgeois economists, is that they have no fundamental understanding of the capitalist economy only a superficial understanding.

Being a flat earther does not prevent one from building a house, because for all intents and purposes, a thirty square meter plot, unless it is on the side of a mountain is essentially flat. However, if an engineer seeks to build a 3 km suspension bridge (s)he can no longer be a flat earther because that bridge cannot be built unless the curvature of the earth is taken into account. If an engineer seeks to build a GPS satellite, it is not enough to know the earth is a sphere with curvature, it is necessary to know that this curvature is no longer uniform, and neither is earth's magnetism. Thus depending on the requirement, a more involved and deeper understanding is required.

Flat earther economists can get away with day to day observations of the market. More strategic ones detect the lumpiness in the market. But what they all lack is that deep, deep understanding of capitalism. That is why with few exceptions, they failed to detect the Crash of 2008 which so enraged Queen Elizabeth. And which is why they have failed to understand the significance of the current tremors pre-dating the new Crash.

In the old days it was said of computers, that if garbage went in garbage would come out. Today algorithms intervene filtering out some of the garbage going in. We thus have to modify the rubbish in rubbish out slogan. Instead we should say, a rubbish algorithm ensures that data going in is converted into garbage coming out.

There is an additional problem in a market driven by algorithms. It is the noise they generate. The *Economist* misses the point when it quotes seasoned investors who worry that algorithms chase securities with given characteristics only to dump them when these securities become too expensive

breaching the "given characteristics". This is a minor element. We recall that algorithms are data driven. But these algorithms are themselves altering the data sets whenever they execute orders in the market. There is thus an enormous amount of looping going on. If enough of them modify the data by adding to it, they create a massive false positive. If we take the case of momentum, this means they add to the momentum which adds to the momentum regardless of economic logic.

What should we call these kinds of superficial algorithms? The correct term is psychological algorithms which reflects the psychology of the market and those that populate it. The fact that these algorithms are mathematically complex and burn lots of computer time is by and by. Maths without the correct assumptions is like a car without a steering wheel. Elegant but directionless.

It appears the *Economist* has a premonition of the pending algorithm led Crash. *"The greatest innovations in finance are unstoppable, but often lead to crashes as they find their feet."* Here the *Economist* is not only looking forward but backward to the bubbles created by advent joint stock companies in the 19th Century that gave rise to things such as the overinvestment in railways.

Where the *Economist* is wrong is to declare "computers don't panic". This is a misreading of the situation. The psychology of the market is the catalyst which in the end determines, whether greed or fear, will prevail. Thus algorithms which dig into these attitudes are not without momentary merit. Marx made the important observation: that consciousness tends to lag objective reality. Greed tends to extend the bull run, whereas fear tends to extend the bear run. In short, changing conditions precede the recognition of these changes and even more, revised decisions based on this new recognition. Often these new conditions or developments have to become established before they attract attention or affect decision making.

In this context psychological algorithms are a double edged sword. On the one hand they could reinforce the psychology of the market by both chasing momentum and adding to it, long after the fundamentals have changed. On the other hand, they could be programmed to detect changes in conditions faster than the human brain, that is the brain of the investor, can detect provided they are looking in the right direction. In the former case they would perpetuate the existing run, in the latter limit it. It all depends on which set of programmes are dominant and which carry the most financial weight. If the former set of programmes are in force, and the statistics given earlier in the form of ETFs suggest they are, then these algorithms will cause a panic by driving the markets off a higher cliff than would have been the case, were seasoned investors in charge. They could set off an unprecedented panic as algorithms collectively reverse their trades and head for the exists more quickly and brutally than human investors ever could.

In the aftermath of the 2008 Crash, Mr Greenspan, who had been the long standing chairman of the FED, admitted that he did not understand sub-prime instruments due to their complexity. No doubt in 1919 and 1920 in the aftermath of this crash, the same bullshit will be admitted to. We are bound to hear the same sorry individuals declaring: "we did not understand the algorithms, not only were they too complex but they had a life of their own".

When is a trade war deal not a deal, and, when is quantitative not actually quantitative easing?

The markets have recovered their mojo over the last week. This has happened, not because fundamentals have improved, they continue to deteriorate, but because the FED has become more interventionist and a trade deal has been "achieved".

In 2008, it was the major investment banks that were propping up the markets, especially the mortgage market despite mortgage defaults skyrocketing. These days it is the government, especially

the White House and the FED. No doubt all the algorithms have been tasked to focus on monetary policy and the trade conflict. They are alert to any developments with high frequency traders determined to be the first off the block. But all is not as it seems. Take the trade deal, it was anything but, it was a truce, an agreement not to escalate, therefore a deferred agreement. But to algorithms seeking out key words, Trump's valorous triumph was sufficient. The maths did not get the nuances or maybe they will over the weekend as more critical human comments emerge in cyberspace.

The FED itself plays a nuanced game. On Friday morning *Bank of America* opined "*the Fed needs a bazooka of asset purchases." However, they said, that's unlikely to happen, and the central bank will probably buy only $25 billion to $50 billion a month in Treasury bills, "to guard against the perception of QE."* That afternoon the FED did unpack its bazooka, announcing monthly $60 billion purchases of assets, having already spent $180 billion propping up the REPO market which it promised to continue supporting. https://finance.yahoo.com/news/fed-brings-bazooka-fight-repo-170254896.html

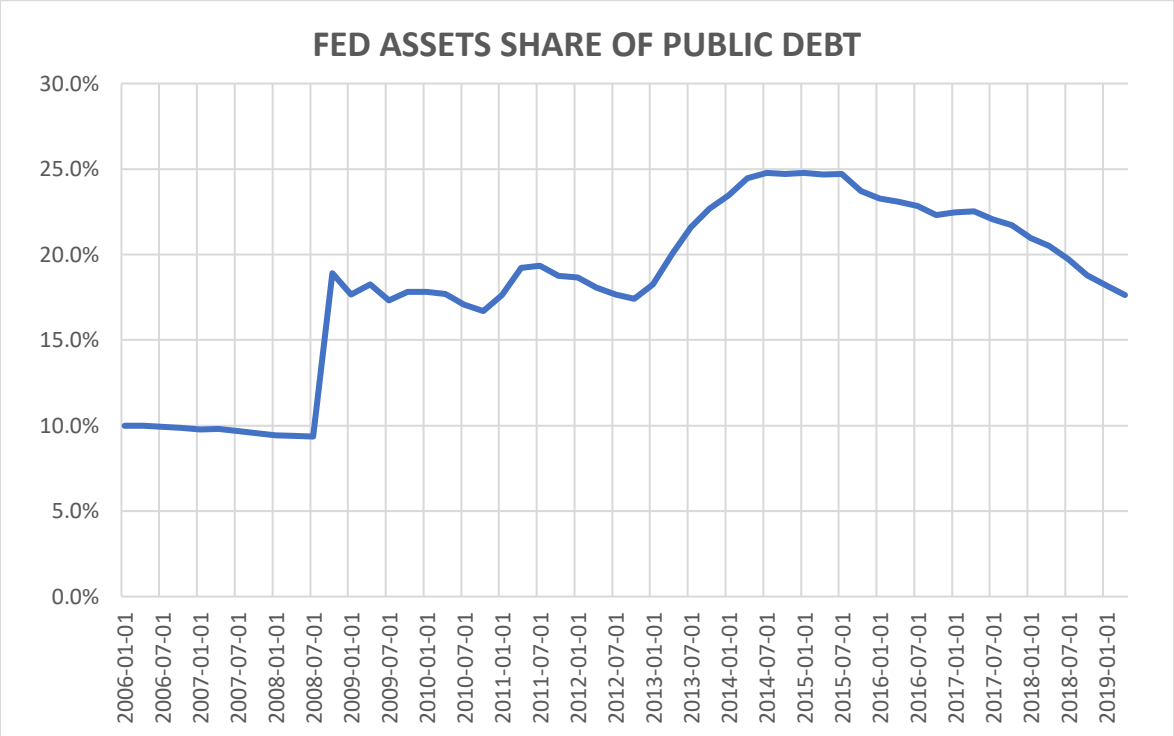
According to the FED, these are not crisis measures, merely technical measures. "These actions are purely technical measures" and "purchases of Treasury bills likely will have little if any impact on the level of longer-term interest rates and broader financial conditions." Why is the FED being so coy and going to such lengths to fool the algorithms? If the FED was to admit to crisis conditions this would undoubtedly spook the markets and confuse the algorithms. Instead it says it is adding reserves not easing monetary policy because the unwinding of its balance sheet was overdone.

Hmmm. The graph below suggests this cannot be correct. Prior to the 2008 Crash the assets of the Federal Reserve was under $1 trillion or in inflation adjusted terms, around $1 trillion. At its height, up to 2018, it stood at $4.5 trillion. The unwinding up to the REPO emergency amounted to just $700 billion leaving the assets at $3.78 trillion or nearly 400% higher than prior to the 2008 Crash.

Graph 1.

It may of course be argued that since 2008 the economy has grown significantly and public debt more so, due to growing fiscal deficits. However, even when a comparative analysis is done, the results still indicate that the cause of the growing financial crisis is not the one provided by the FED. Graph 2 provides the result of this comparative analysis. Public debt may be elevated at $22 trillion currently, but so too is the FED's balance sheet. Admittedly, the ratio has declined 50% since 2015, but Fed Assets as a share of Federal Debt are still 70% higher than the level obtaining before the 2008 crash.

Graph 2.



(Sources: Fred Table GFDEBTN for Public Debt & Table WALCL for FED Assets.

The real problem is the age old one for capitalist firms and banks, lack of liquidity. FactSet's latest earnings insight (11th October) projects annual revenue growth of only 2.7% with profit margins down 2%. This combination is lethal for cash flow. In reality, adjusted for share buy backs, inflation and creative accounting, this implies a sharp reduction in both cash flow and its unpaid element. In a previous posting I highlighted the issues facing the tight oil industry in the USA where negative cash flow is endemic. It is likely the same applies to an increasing number of industries and the banks that make up their deficits.

Conclusion.

The next three weeks, which constitutes the reporting season for the third quarter, will be a stern test for the algorithms. The profit motive is the driver of capital. It cannot be ignored and when it is, it comes around with doubled force. At the beginning of year the projection was for a rebound in profits in the second half of the year. The opposite has materialised, profits have fallen and will continue to fall despite the truce in the trade war. The question is, will the algorithms give due weight to this or will they continue to focus on monetary policy and trade war tweets. If they do, this will only delay the crash, but at the expense of engorging it. We shall know shortly.

Brain Green 13th October 2019.