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The struggle SARS-CoV-2 vs. homo sapiens—Why the earth stood still, and how will it keep moving on?

Tessaleno Devezas

Atlantica School of Management Sciences, Health, IT & Engineering–Center for Aerospace Science and Technologies (C-MAST–FCT)–Lisbon, Portugal

The above title reminds us of Robert Wise’s 1951 science fiction film (and the remake released in 2008 as well), but this time the planet is not threatened by aliens, but by a Terran nanosized enemy with comparable power.

Since the World Health Organization (WHO) declared the new Corona virus a pandemic on March 12th 2020, many friends of mine and colleagues from the scientific community, knowing that I work with Futures Studies and Forecasting Methods, have flooded me with questions such as: What is happening? Why wasn’t it predicted? How can the end of this pandemic be predicted? As well as the inevitable question: is it a Black Swan?

Regarding this last question, Nassim Taleb, who created the concept in his 2007 opus ‘The Black Swan – The Impact of the Highly Improbable’, has already manifested his irritation in the article published in The New Yorker titled “The Pandemic isn’t a Black Swan, but a Portent of a More Fragile Global System” (Avishai, 2020). In fact, we can’t classify this pandemic as a Black Swan, when so many people foresaw the menace and imminence of a serious global epidemic, including Bill Gates (several talks and interviews), Vaclav Smil, Michael Osterholm, Jeremy Konyndyk, and others (For an interesting list see Hoffauer, 2020). In this context it’s important to mention two of Taleb’s prophetic statements in his 2007 book: “As we travel more on this planet, epidemics will be more acute; we will have a germ population dominated by a few numbers, and the successful killer will spread vastly most effectively”, and, in my view more impactful, “I see risks of a very strange acute virus spreading throughout the world” (Taleb, 2007).

My intention with this article is to contribute new insights that, as far as I know, have not yet been properly considered in the countless analyzes that have already appeared on the topic. Some of my points have close relation with Taleb’s general idea but bring to light a few other hidden aspects related to the sciences of Complex Systems and Historical Analysis, and the concept of Kondratieff longwaves as well.

I want to address two main questions:

Primo: Why the surprise? Secondo: What comes next?

- Concerning Primo: Why the surprise?

As can be inferred from all the above exposition, the surprise lies not in the emergence of the pandemic itself but lies in its profound and breathtaking effect on the global socioeconomic system, in the very short period of less than three months.

History tells us that there have been major pandemics in the past that claimed millions of lives, and even more recent epidemics have caused thousands to some millions of deaths (H1N1–1956–1958, HIV–1976, Ebola–2013–2014, SARS-CoV–2003, H1N11 – 2009, MERS-CoV – 2012, just to mention a few), but none of these more recent epidemics have had any significant impact on the global economy. To effectively address the ‘surprise effect’, we must analyze the phenomenon according to two main and not related aspects: first, the structure of the global political and economic system, and second, the characteristics of the new virus (SARS-CoV-2).

Regarding the first, I would like to bring to the reader’s memory a discussion published in TFRSC in 2010, ‘From My Perspective: On Ferguson’, with contributions of mine, George Modelski, Theodore Modis, and Harold Linstone (Devezas, 2010a). The discussion was prompted by Niall Ferguson’s article published in Foreign Affairs titled “Complexity and Collapse: Empires on the Edge of Chaos” (March 2010). Ferguson’s motivation at that time was the same as ours today — an explanation of the worldwide perplexity in the face of the unexpected economic shock that happened as consequence of the defaults on sub-prime mortgages, which first produced a surge in 2007 in the United States, and then tipped the entire world economy into a financial blackout that lasted for at least two years (2007–2009).

Ferguson expressed his thesis asking: “What if history is not cyclical and slow moving but arrhythmic—at times almost stationary, but also capable of accelerating suddenly, like a sports car? What if collapse (of Empires) does not arrive over a number of centuries but comes suddenly, like a thief in the night?”. With this kind of ‘what if’ questioning, Ferguson was challenging political leaders, who usually think of current economic crises facing the US as being the consequence of just long-term threats.

For him, empires, and the human society as a whole, are complex systems operating somewhere between order and disorder – on the edge of chaos – and consist of systems that are constantly adapting and are
prone to a dramatic and sudden phase transition in consequence of some small contingent occurrence coming from within or without.

In my contribution to the debate titled “On phase transitions, catastrophes, and sudden changes” I expressed my opinion that Ferguson’s conceptual framework is not all bad, but in the odds considering the exaggeration of some conclusions and the bad use of some basic physical concepts. To a physicist’s eye his analysis has a touch of naïveté and under some aspects does not represent anything new.

I suppose that Ferguson was somehow influenced by Taleb’s view that ‘History does not crawl, but it jumps’ (chapter 1, pg 10, in The Black Swan), but he took his argument in a wrong way — Taleb speaks mostly about unpredictability (and levels of unpredictability) and not about causality. Ferguson tries to lock-in ‘immediate causes’ for disruptive historical events and overlooks the fact that in complex systems jumps are the result of running the evolutionary algorithm, which can only be understood through back casting, exactly what historians and evolutionary biologists do, and what Ferguson criticizes. To fundament his arguments Ferguson speaks of ‘phase transitions’ and uses the canonical example of SOC (self-organized criticality) — avalanches in a pile of sand. In both cases it is a regrettable misuse of physical concepts, above all because these are phenomena of completely different natures.

The reason why I choose to address here Ferguson’s misinterpretation is because I have seen some ‘experts’ interpreting the current phenomenon as something absolutely unexpected. It would be boring to reproduce here much of the content of my 2010 analysis but while would like to address shortly the important aspects of SOC and of the pile of sand, for they are paramount for correctly depicting the above mentioned “surprise effect”.

The process of self-organization in complex systems takes place over a very long transient period! Complex behavior, whether in history, biology or geophysics, is the result of a long process of evolution. It cannot be understood by studying the system within a time frame that is short compared with this evolutionary process. As very well stated by Per Bak in his 1972 opus “How Nature Works” — “the phrase ‘you cannot understand the present without understanding history’ takes on a deeper and more precise meaning”. In other words, there is no such thing, as Ferguson tries to convince us, of an independent event that can be seen as the main causation of a sudden and/or abrupt change — an evolutionary process is the result of the succession of stasis and accelerations.

Now to the case of the pile of sand. A sandpile exhibits punctuated equilibrium behavior, where periods of stasis are interrupted by occasional sand slides, or small avalanches, caused when a single grain pushes many other grains and causes them to topple. Sometimes one observes a much larger avalanche, collapsing a large fraction of the sandpile, after which a new period of stasis follows and the sandpile grows again. It is very important to observe in this simple example that large catastrophic events occur in consequence of the same dynamics that produces small ordinary everyday events. This last observation runs counter the usual way of thinking about disruptive events, which looks for specific reasons, but is not the only consequence of the last occurring event. That single grain of sand that caused the larger avalanche would not cause the collapse if all other grains of sand were not there previously, distributed in a given geometric form, under the action of the gravitational field and submitted to their mutual interaction forces. It is important to recognize that the collapse (or sudden change) happens because some threshold was reached, and the path until this critical point is a function of the previous evolutionary history of the system. Summarizing, history does matter indeed and physicists as well as evolutionary biologists know this very well.

As seen, the surprise does not lie in the emergence of the pandemic itself, for it was predictable, but instead was due to the immense accumulation of GRAINS that make up our modern global socioeconomic system, mostly characterized by uncontrolled excesses: ungoverned multidimensional globalization, physical connectivity (mass movement of people and goods), aggression/depletion of the environment, disruption of the wild habitat, and many more. Worse, this whole new establishment that emerged in force for the last 40 years (1980—2020) was managed by institutions and conservative policies that had consolidated in the previous 30 years (1950—1980) or earlier. The present picture is of a European Union falling apart, and an accumulation of criticism for the United Nations (founded in 1945) way of acting and ineffectiveness in resolving enduring situations of regional conflicts. Now, UN’s agency for health, WHO (World Health Organization, created in 1948) has notoriously failed to effectively coordinate an international preventive action to mitigate the impact of the already announced possible of a pandemic. Add to this a global scenario of left-right polarization that is not very different from what we had at the beginning of the 20th century, and a weakening of democratic regimes when compared to the apparent strengthening of totalitarian regimes.

The saturation was reached — the collapse-like avalanche was unavoidable.

But in the case of the actual collapse, the threshold was reached through the mutual interaction of two decisive GRAINS: too much connectivity and the very peculiar properties of the SARS-CoV-2. This interactions was catastrophic in the sense that it has revealed the fragility of our institutions and led to rapidly cascading effects on governmental and financial systems, which were prone to blow. The question that naturally follows is how to build systems of governance and trade that can handle probable (but unforeseeable regarding their exact timing) random events like a global pathogen outbreak? It is not my intention to address further this point in this short article, but I return briefly to it when considering the other question (secondo: what comes next?).

Finalizing now our primo question, let us consider shortly the mentioned peculiar properties of this new virus. Among the epidemics I have mentioned earlier (pg2), it is necessary to distinguish between those that require body contact (body fluids) to infect (like HIV and Ebola) and those characterized as airborne infections that spread when bacteria or viruses travel on dust particles or small respiratory droplets. This latter group, despite a much lower lethality than the first group, constitutes the greatest threat as a global pandemic due to its greater ease of propagation through the mass movement of people in transport vehicles: trains, buses, ships, and airplanes.

Airborne infections are caused by a wide family of viruses, including those that induce common cold, flu, and/or respiratory syndromes, that, as we know, have plagued humanity with some severity since the beginning of the 20th century. Among these we find the HxNy viruses (H2N2, H1N1, H1N2, etc., depending on the H or N antigen-proteins that expresses its metabolic synergy with living cells), mostly known as influenza viruses. The last serious pandemic provoked by this strain of virus was the 2009 H1N1 swine flu, which caused about 500,000 deaths worldwide (CDC, 2012). Some strains of this family of viruses are now endemic among humans (seasonal flu). Important to note that there are estimates that globally, influenza causes more than 600,000 deaths per year (Dalzell, ABC News, 2020).

But the target of my analysis here is another family of this group (airborne), also zoonotic pathogens, classified as the corona family, which include the now very well-known viruses causing SARS (Severe Acute Respiratory Syndrome) and MERS (Middle East Respiratory Syndrome) — both resulting of a very recent mutation of a older flu-like virus first identified in 1964 (Combs, National Geographic, 2020). These infections can manifest as bronchitis, pneumonia, or a severe respiratory illness.

The coronavirus that causes SARS is called SARS-CoV (for Coronavirus). According to WHO, the first cluster of SARS cases occurred in China’s Guangdong province in November 2002. Studies identified then horseshoe bats as the natural reservoir of SARS-CoV. Civets and other animals in wet markets may have contributed to the virus crossing from animals into humans. On March 2003, the WHO issued a global alert, warning of an atypical pneumonia spreading from China and coined the
name SARS for the disease. Right after the first alerts the organization put out an emergency travel advisory and recommended that airports start to screen passengers coming from countries with cases of SARS – it was the first case in history of an alert about the possibility of an epidemic being propagated through people using air transport.

In 2012 it happened the outbreak of MERS, whose route of infection was probably the direct or indirect contact with dromedary camels. WHO coined the causing pathogen as MERS-CoV, and since then about 30 countries have reported cases of MERS. Curiously, the $R_0$ (R-naught – the measure of transmission among people) of MERS is far lower than that of SARS, but its mortality rate is far higher (~34% for MERS, and ~10% for SARS).

Before considering the case of our actual COVID 19, caused by the SARS-CoV-2, as well as some important comparisons with the outbreaks of SARS and MERS, it is paramount to make a point about air traffic. In a recent article of mine submitted to TF&SC (Devezas, 2020) I call attention to the exponential growth of air traffic in the last 50 years. According to World Bank data (https://data.worldbank.org/indicator/IS.AIR.PSGR), the number of passengers carried in 2002 amounted to 1.64 billion, in 2012 to 2.89 billion, and in 2019 to 4.54 billion, which implies in total growth of 177% in seventeen years, or a growth rate of about 10% per year! In other words, the best vector for transmitting the virus has expanded vigorously.

A corona virus consists in a single-stranded RNA genome enveloped by a nucleocapsid (protein shell) of helical symmetry. An important characteristic of this virus family is that they are the largest RNA viruses, measuring about 30 kbp (kilo base pair), ca. 1 μm, the double of the HxNy viruses, which measure in average 15 kbp. As evolutionary biologists know, viruses are an important means of horizontal gene transfer, which increases genetic diversity. The fact that corona viruses are the largest class of RNA-virus in action, allows them a key evolutionary feature: having a much longer RNA strand they have a greater chance for mutations and plastic adaptability to the environment (living organisms where they reproduce). This is the core point of my consideration of this key issue:

Concerning Secondo: What comes next?

On this point I would like to recall another paper of mine published also in 2010 in the pages of TF&SC titled “Cries, Depressions, and Expansions: Global Analysis and Secular Trends” (Devezas, 2010b). The objective of the work at that time was to offer an interpretation of the 2007–2008 financial crisis (also coined as Great Recession) in the framework of the Kondratieff waves, as well as comparisons with previous crises. Moreover, I offered an interpretation of the reason for the crisis and a forecast on the paths of the global economy for the next 20 years. Four main economic agents – world population, global output (GDP), gold price, and the Dow Jones index – were minutely examined using data from several sources. Without going into details about the methodology used, I summarize the main conclusions below:

1. Fingerprints of Kondratieff longwaves are ubiquitous in all observed time series used in this research—world GDP growth rates, succession of economic expansions–contractions in the US, purchasing power of gold and the historical ratio DJIA/gold price;
2. Regarding the present crisis we can state that it has some unique characteristics, which distinguish it from all previous economic depressions. Despite its unique characteristics a parallel with the panic of 1907 may be drawn—both have occurred amidst a strong international growth period and are perfectly symmetric in the observed space–time pattern;
3. The most important conclusion concerning this crisis is that it seems to sum up a mix of a self-correction mechanism that brought the global output back to its original logistic growth pattern and signals an imminent transition to a new world economic order;
4. The next decade will be probably one of worldwide economic growth, corresponding to the second half of the expansion phase of the fifth K-wave, but that will saturate soon after the 2020s;
5. There are strong signals that we are already witnessing a transition to a new global socioeconomic system, which will carry within it a profound restructuration of world economic affairs, with a multipolar world leadership and a new world currency.

These results were reached through application of trend analysis
using logistic curves, spectral analysis of time series, and the singularity approach, all of them converging to the same general result of an evolutionary trajectory leading the world system toward a probable age of transition.

Regarding the conclusions of points 2, 3 and 4, I have to say that I'm confident in affirming that they were correct, because in the following years after the publication the trajectory of the global economy corresponded to perfection the extrapolated curve presented in the Figure 13 of the paper (Devezas, 2010b). In 2010 the global GDP jumped up to a growth rate of 4.3% p.a., and in the following years exhibited a slight downturn with an average of about 3% p.a., signaling the approaching peak of the 5th K-wave.

Concerning the point 5, the transition to a new global socioeconomic system, also mentioned in point 3 (an imminent transition to a new world economic order) I have not delved into the analysis because I was not sure about two main points (see below) which would require a more detailed research. I limited myself to indicating only the trend of the curves and commenting on the observation that real growth rates of low-income countries have been growing increasingly apart from those of high-income countries. The fact is that since the onset of the Industrial Age high-income countries have contributed with at least about 70% for the global output measured as world GDP growth rate. This trend was maintained up to the mid-1990s, but after this point, and up to 2007, growth contribution from low-income countries surged by more than threefold, from around 10% (mid 1990s) to almost 35% (2007). In the mid-1990s high-income countries contributed with 77% for the global output growth, and low-middle-income countries contributed with 23%. Presently these numbers have radically changed to 95% from low-middle-income and only 5% from high-income countries. See for instance that, according to IMF (2020), in 2018 the world GDP grew at 3.6%, with advanced economies growing at 2.2%, while developing economies grew at 4.5%. Such change may well be interpreted as a signal to a transition to a new world economic order with a multipolar world leadership. As demonstrated by Devezas et al. (2017) the driving force for this radical change was China’s modernization, a process that has started slowly in the 1980s, but accelerated enormously in the 1990s – in 1992 China’s annual GDP growth reached the incredible mark of 14.3%. After a slight decline in the second half of the 1990s, China’s output continued to growth unabated in the first decade of the 21st century maintaining the two digits mark during most of this period. Importantly, during this period, China’s global economic significance of course increased and in 2010 China became the world’s second largest economy, and now more than twice as large as that of Japan.

With regard to the two main points mentioned above, about which I was not sure at the time I published that work, they were: 1 - the phenomenon of dematerialization, and 2 – the possible end of the pattern of the Kondratieff longwaves, at least as we have interpreted them until now. Both points are somehow inter-related and have to do with the aspect of the growing relevance of intangible assets in the current socioeconomic system.

In the last few years, I have driven my attention more intensively to the investigation of point 1, which resulted in the publication of three articles– Magee, Devezas (2017), Magee, Devezas (2018), Devezas et al. (2017). The objective of this research, which was conducted in collaboration with my colleague Chris Magee (MIT, Materials Division), was to survey the worldwide production and consumption of a basket of 98 materials most used in modern engineering applications in order to find patterns of dematerialization and or materialization during the last half century. The results do not enable us to state that human society is ‘dematerializing’, but we have pointed out that there are some positive trends which allow us to be optimistic regarding a reduced per capita consumption of materials in the future and less harm to the environment as well. In a nutshell, the patterns found indicate that business is not simply proceeding as usual, for the ever-increasing technological capability is contributing to an ever-improving efficiency in the usage and production of materials, allowing a hopeful vision of a future scenario that, if not showing absolute dematerialization, is evidencing a stabilized and sustainable path allowing economic growth without continuing increased material consumption.

Our results demonstrated that among the 98 materials investigated, at least 51 materials were evidencing some type of dematerialization or reducing their per capita consumption. Some may argue that this result is mainly due to a global picture of economic degrowth in the last couple of years. But regarding this point it is important to consider that many economists are suggesting that we are experiencing neither a global recession, nor a normal economic crisis, but instead that the global economy will not return to the roaring economic growth verified in several periods of the last sixty years. We call the attention to the fact that economic growth is not happening as it used to be, in other words, wealth is being created without necessarily more material consumption – our analysis demonstrated that, from the basket of 98 materials studied, humans needed to consume 480 g to produce one dollar output in 1960, and now can produce the same dollar with only 200 g.

Regarding the second point (end of the pattern of K-waves), unfortunately I have not published about it yet, but my students are witnesses of how I have insisted in this idea in my classes over the past few years. The reason is simple: past Kondratieff longwaves (K-waves for short) were supported at large by material-based radical innovations and novel artifacts, and huge industry complexes to produce them. Now we are witnessing the burgeoning of a completely new economy, not so strongly based on the exponential growth of material and energy consumption, but instead in a new vast and invisible digitalized ‘second economy’ (Brian Arthur, 2017), and a series of intangible innovations that are forming a very strange new virtual world. This a completely new ‘technosphere’, without any comparison with the previous ones. It might be better to devote some more objective words on this subject, which is relevant to our final consideration about what is next?

Over the past 250 years, since the inception of the Industrial Revolution (IR for short), the occurrence of at least four K-waves has been observed, and we were now experiencing the end of the expansion phase of the 5th K-wave. Each of these previous K-waves defined a clear ‘technosphere’ (Devezas, Correidne, 2001) designed by the leading basic innovations of that period, a not very different view from that of the successive IRs (1st, 2nd, 3rd) defended by mainstream economists (Schwab, 2016), who say we are experiencing now the 4th IR. According to the neo-Schumpeterian school of economics (or evolutionary economics) the global economy is a far from equilibrium open complex system with an endogenous self-regulatory mechanism, characteristic of the self-organized complex systems. Such mechanism consists in the periodic swarming of basic (or disruptive) innovations that concentrate during the phase of economic recession, with a period of about a half-century. According to the Schumpeterian concept of creative destruction, these downwave swarming of innovations triggers the following upwave phase of economic expansion, during which the bunch of new radical technologies interact synergistically giving birth to a completely new ‘technosphere’.

But whatever school of economic thought we follow (evolutionary with K-waves, or mainstream with successive IRs), the fact is that now we are witnessing the birth of a completely new socioeconomic paradigm, probably the most important global change ever experienced by the human civilization. Things are now very different, the concept of innovation itself has changed a lot, means of wealth production are no longer what they used to be. During the previous IRs, or the equivalent K-waves, we have had the emergence of massively materialized industrial sectors based on the introduction of radically new material-based artifacts, generating a myriad of new jobs and professions. Today’s means of wealth production are not more based in the mass production of artifacts, but instead increasingly decoupled of material consumption and cardinality based on intangible innovations and assets; the Internet, e-mail, home banking, e-commerce, artificial intelligence, augmented reality, social networks, and much more, are the hallmark of
our modern life (Linstone and Devezas, 2012). Millions of jobs are being vaporized in a rhythm never seen, while other are emerging, towards the creation of billion-dollar companies, the so-called unicorn companies, which are conducted by a reduced number of highly skilled professionals.

A consequence of the present pandemic is the emergence of what has been coined as the "new normal", a situation that probably will last for many years as consequence of health concerns. The necessary social distance may dampen travel demand, business travelers probably take to use more remote working, driven by cost reduction as well while as having become accustomed to remote business practices during the pandemics.

In summary, we have now a very different reality, strongly based on the virtual cyber-physical systems world, which carries with itself the necessity of a profound structural change of production means, trade, education, and social organization. Governments, entrepreneurs, businesses, and every citizen in the world need to adapt to this new globalized digital landscape. INFORMATION is now the most valuable commodity and we can not assign it any value. How much is 1 bit of nesses, and every citizen in the world need to adapt to this new globalized digital landscape.

(ii) researchers of K-waves should further investigate if the pattern of K-waves may be broken or not, and alternatively, investigate the possibility of interpreting the pandemic as a radical innovation itself.

Returning to my 2010 essay ‘From My Perspective: On Ferguson’, where I point out the fact that ‘History matters’, I would like to close this opinion article with the same conclusion, which remains very actual:

What happens, for the time being, is that we don’t know yet how to tackle with this history dependence, in order to bring it into our favor.

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