

The New Global Economy between a Well-Planned Journey and a Chaotic One. Under the Impact of both Climate Change and the Post Pandemic, the NGE: A More Complex and Less Predictable System

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Abstract

The article is devoted to the understanding of the emergence of new traits of the global economy under the impact of climate change and the COVID pandemic. Economic research is nowadays primarily oriented towards the unpredictable and sometimes confusing situations related to the consequences of climate change. Global economy is a complex behavior with a new dynamic. If green energy is to be the main predictable feature we are confronted with three questions: is it robust, sustainable and resilient? The new global economy is not about a bright future; it is about selecting a positive norm that indicates today a positive behavior of it. Hydrogen fossil issue, electricity becoming a tradable commodity, the new role of nuclear energy as a crucial complement to renewables are among the main contributors in redesigning energy markets. We can safely say that by mid-century the world will need to remake its energy system. Indeed, while the science of climate change is today firmly established on powerful truths, the final outcome is not a simple extension of present-day trends. The environment, under the impact of climate change, is presently in a disordered phase of transition. Global disorder should not be inevitable even if critical thresholds seem to be inevitable. The obvious solution is cooperation out of what we believe to be true. We have to act in the presence of uncertainty and often that means that a better situation could be simply an unattainable one.

Keywords: complex systems, global economy, energy, environment

1. Introduction

The New Global Economy cannot be about molding society as if we can see far into the future. Why? Because the global economy is a complex, more often than not disordered system, because it is a dynamic system, which is a non-linear unpredictable one. The transformation we seek is towards a better, timelier and more rational decision-making. Real-time revolution is also, or should be, about alternative and augmentative communication.

Complex behavior is all around us. The economy has many components, each with its own set of rules and all of them interacting in complicating ways. The behavior of the system is strongly sensitive to the initial conditions which are not, as a rule, under our control. It doesn't mean that we are compelled to navigate without a compass. We can select the elements which drive the evolution of the system towards a more predictable behavior as well as knowing better the already present elements of it. While climate change is predominant in the global approach of the economy, we can't say that all comes down to this challenge and how to mitigate its consequences.

A global environment under uncertainty should be considered within the reality derived from complexity. Mastering complexity is the next big challenge for science. Understanding and managing complexity is of critical importance if we are to find ways of solving environmental challenges such as global warming, and if we are to build societies that do not destroy themselves through conflict and war.

Eliminating the carbon gas emissions inevitably implies higher energy costs and slower growth. There is no miraculous economic boom. Let's take the hydrogen-fuel issue. The cost of producing massive amounts of hydrogen from renewables is nowadays five times greater than from natural gas. Everything meaningful should be a combination imposed by complexity. NGE is revealing perhaps, among other energy related solutions, an era of electricity becoming a tradeable commodity thanks to connecting power grids. Matching supply and demand by transferring electricity across distance. Nuclear power needs to be reconsidered as a lot greener than gas. Nuclear

energy is crucial as a complement to renewables. Indeed, nuclear provides always available power when renewables are naturally restricted by the lack of wind or sun. It is an ambivalent connection. There is also an important advantage: it has a small footprint. Less than 1% of the solar or wind needed. Whenever we attempt to resolve conflicting claims, we try to avoid unexpected decisions or outcomes.

We are compelled to produce more with less. How? By learning from nature and mimicking nature.

Without working procedures to induce cooperation, we cannot enjoy the benefits of civilization and of the formidable technological progress.

2. The New Global Economy

Ervin Schrödinger, in “What is Life?”, states that: “Life seems to be an orderly and lawful behavior of matter, not based exclusively on its tendency to go over from order to disorder, but based partly on the existing order that is kept up.” (Schrödinger, 2013)

The NGE, as any other economy, is about maximizing jobs and growth. The pandemic is becoming a catalyst for change. The essence of post-pandemic economic policies represents a real-time revolution, i.e., quality and timeliness of information emerging from using instant available data. Indeed, digital devices, monitoring all kinds of economic and commercial activities, machines and objects tracked with sensors, have become ubiquitous. Improved data and new ones developed in a perpetual feedback loop. In fact, we are dramatically increasing our ability to observe the economy accurately and, in doing so, improve it more quickly. And even more remarkably, battering the decision-making process in the public sector is of utmost importance. The gap between official data and what is happening in the real economy is often flagrant. And so often there is no time to wait for reports and official surveys. Bad and late data cause errors and jobs and lots of money is lost. There is a strong demand for economic research to understand the unpredictable and confusing situations.

A documented example is the financial crisis, when the Federal Reserve cut interest rates to near zero in December 2008, when America entered recession. Had the Federal Reserve cut them in December 2007 (one year earlier), the financial crisis would have been a lot less harmful. Now, real-time policies do not eliminate or reduce the work of statistical agencies. The NGE cannot be about molding society as if we can see far into the future. Why? Because the global economy is a complex, more often than not disordered system, because it is a dynamic system, which is a non-linear unpredictable one. The transformation we seek is towards a better, timelier and more rational decision-making. Real-time revolution is also, or should be, about alternative and augmentative communication.

Complex behavior is all around us. The economy has many components, each with its own set of rules and all of them interacting in complicating ways. Last year (2021), the Nobel Prize for Physics was awarded to Giorgio Parisi, a physicist who uncovered the hidden rules that govern complex disordered systems, i.e., the properties that emerge from the random, disordered movements of particles on the microscale, at the macroscale level. Such a mix of complexity and emergent behavior is also the economy and the ecosystems under the impact of climate change, the biological phenomena or the financial systems. It's often much more difficult to predict the behavior of a highly complex system like the global economy or a global financial one. And we are well aware that NGE should not denude the planet of its resources. That is the only way towards a sustainable future.

NGE is a complex system and the questions around this new dynamic are, as before:

- 1) Is it robust? Which are the engines of growth?
- 2) Is it sustainable? Can we replicate the conditions of growth in the long-term?
- 3) Is it resilient? When the system is submitted to shocks, which are inevitable in a world full of uncertainties, does it withstand the shocks and bounce back to a normal state, perhaps even a better one?

The behavior of the system is strongly sensitive to the initial conditions which are not, as a rule, under our control. It doesn't mean that we are compelled to navigate without a compass. We can select the elements which drive the evolution of the system towards a more predictable behavior as well as knowing better the already present elements of it. While climate change is predominant in the global approach of the economy, we can't say that all comes down to this challenge and how to mitigate its consequences. As we stated before, the initial conditions are more diverse.

In his famous paper “Complex Systems: a Physicist's Viewpoint,” Giorgio Parisi gave a definition of the complex system: “A system is complex if its behavior crucially depends on the details of the systems.” (Parisi, 1999).

Threats to the future are not only natural (physical or biological), they are also political. The cultural propensities of people and communities don't disappear. When they evolve, there is only an alteration of the existing ones.

It is important to notice that acknowledging the threats to the future of a global zero-carbon economy it shouldn't be that we somehow become the moral slaves of that future. Under the threats we can still imagine and compute new routes and new solutions. A global environment under uncertainty should be considered within the reality derived from complexity. Mastering complexity is the next big challenge for science. Understanding and managing complexity is of critical importance if we are to find ways of solving environmental challenges such as global warming, and if we are to build societies that do not destroy themselves through conflict and war. Stephen Hawking said that "the present century will be the century of complexity." Heinz Pagels was more specific: "I am convinced that the nations and people who master the new sciences of complexity will become the economic, cultural and political superpowers of our century." (Pagels, 1988).

In physics we reach a critical point when a series of conditions – with decisive impact on the system – have the same intensity. They are temperature, pressure and density. In economy there are four fundamental things:

- 1) Capital (investments);
- 2) Energy;
- 3) Trade and commerce;
- 4) Labor force.

So, what would be the most reasonable policy expectation about the NGE? Eliminating the carbon gas emissions inevitably implies higher energy costs and slower growth. There is no miraculous economic boom. Behind the shortages (energy, transport, semiconductors) there are deeper forces which can stay even for a long-term period. Green alternatives are not solving the problem of shortages. On the contrary. That shows, among many other things, the new complexity of the global economy. The NGE is not about a bright future. It is about selecting a positive rule among many possible rules, a rule that indicates a positive behavior of the global economy. Green should transform itself from truism into beating reality.

Let's take the hydrogen-fuel issue. The cost of producing massive amounts of hydrogen from renewables is nowadays five times greater than from natural gas. Everything meaningful should be a combination imposed by complexity. For example, kilowatt-hour produced is not equal, either in terms of negative consequences, or of costs.

- 1) From what source of energy is hydrogen produced?
- 2) When is it very useful to produce hydrogen, with zero or minimal negative consequences and low cost on the market?
- 3) What kind of storage of electricity is beneficial to the investments in hydrogen production?
- 4) Can hydrogen replace the classical sources of combustion in steel production and other industrial activities? (Hydrogen can be pressurised to be consumed in transportation but it can be liquefied only at -253 degrees Celsius)
- 5) How large would the necessary stimulus to supply hydrogen be and how unprepared would the markets for such a move be?

Incumbent technologies (not the black ones, but the gray ones) and the financial constraints of governments could represent a major obstacle.

An NGE is already coming but being a complex system means going even a little off balance and risk having it tear apart. A clear example today is the price surge of the global shipping of goods.

Under the WTO rules, the average global tariff fell between 1990 – 2017 by 4,2%, but for developing countries it fell even more: India 51%; China 28%. The system supported an explosion of global trade as a share of global gross output from 30% in the early 1970s to 60% in the early 2010s.

The international commerce received a great boost from the radical reduction of transport costs and also stability, meaning predictability. Reduction in uncertainty was so important. Today free trade is not a mantra anymore. One reason is the pandemic associated restrictions, but another one is political, related to national protection of inefficient firms. The question appears once more: protecting national firms makes the country as a whole more resilient to shocks?

As developed and militarily powerful states promote, sometimes aggressively, their national big companies (especially industrial), what can the less developed countries do in order to keep up with the general nationalistic trend? The Economist, in October 2021, stated: "In the global economy, power increasingly trumps rules" (The Economist, 2021).

NGE is revealing perhaps, among other energy related solutions, an era of electricity becoming a tradeable commodity thanks to connecting power grids. Matching supply and demand by transferring electricity across distance. Undersea cable-laying is nowadays easily feasible, with advanced technologies, even at depths below 1200 meters. There is an estimation showing that until 2030, 72.000 km of cables will be laid under seas. Another project is also very promising. Before 2030 energy islands – the first one is in the North Sea (Vaughan 2019), with lots of different technologies in one space: wind, battery, hydrogen, connected by cable with one or two or more countries. And size is a crucial factor when returns tend to grow exponentially in time. Remember, we are in the Exponential Age. Be exponential or bust.

By mid-century the world will need to completely remake its energy system and still to face the same crucial issue: to grow again as the demand for improving living standards will continue to manifest itself as it is today.

Redesigning energy markets is possible and very much needed. Bigger safety of the nuclear plants, big reserves not only in gas but also in battery storage and hydrogen are all very near or sufficiently near to technological completion. Climate summit outcome in Glasgow has shown that the world is already falling behind on pledges (to reach carbon -zero emissions) that were never enough to begin with. Nuclear power needs to be reconsidered as a lot greener than gas. Nuclear energy is crucial as a complement to renewables. Indeed, nuclear provides always available power when renewables are naturally restricted by the lack of wind or sun. It is an ambivalent connection. There is also an important advantage: it has a small footprint. Less than 1% of the solar or wind needed. Jean Monnet wrote more than fifty years ago: “approaching our atomic future separately would have been insane.” The present available resources are, in general economic terms, more valuable than future resources. Having resources now means that we can or should expand our opportunities. This is simple economics, yet quite complex at the level of the global economy. The present command of resources is one of the most sensitive issues on the global stage. What stays unchanged when the economy is subjected to symmetrical transformation, i.e. transformations which do not alter the whole validity of the system? (in physics, validity is expressed in the fact that the appearance of the object is not changed). The obvious answer is: cooperation, interconnectivity and trade. We speak a lot about transitions in the global economy. Therefore, we are compelled to speak about some critical points and order parameters. Global economy should also be based on continuously expanding and charging towards the frontier of innovation. Governments and businesses working hand in hand make the economies more innovative.

In a disordered phase of transition, the parameter of order is zero. But, while asymmetries are inevitable, global disorder is not. Even if abnormal behaviors occur, signaled by critical thresholds, patterns do emerge in the long-term.

Examples teach us to organize the multitude of objects in classes. But how many examples do we need in order to extract a rule of certain architecture of the set (system)? It is clear that it all depends on the architecture.

Now, what would be the architecture of the NGE as a system? Intuition, the talent to accidentally discover something true and powerful, have their important place. Umberto Eco, in his essay “Serendipities,” expressed this firmly: “We should rely on a criterion of truth. But if I were to choose it too dogmatically, I would risk ending my argument at the very moment I begin it” (Eco, 1999).

And he quotes Dante (“Paradise”, XXVI): “For no product of human reason, from the human taste for always having something new... is ever stable.”

While the science of climate change is today firmly established on powerful truths, the final outcome is not necessarily a simple extension of present-day trends. We are compelled to produce more with less. How? By learning from nature and mimeting nature.

We are more and more, in some respects again, living in a world where cooperation is challenged by the power relationship or the standing forces. But, let’s remember that the functioning of the economy, along with the functioning of the government and the social institutions, depends eventually on our mutual ability to secure cooperation. Without working procedures to induce cooperation, we cannot enjoy the benefits of civilization and of the formidable technological progress. All discussions on global cooperation should be rooted in and growing out of convictions, i.e. out of what we believe to be true, important and useful. Global cooperation, if it is to become a reality, is about shared convictions. Indeed, we have no option but to act in the presence of uncertainty and often that means that a better situation could be simply an unattainable one. And we should, much more than now, resort to diplomacy as a global tool to cope with global uncertainties.

3. Conclusions

We may consider that the future is a product of interplay between the states of nature on one hand and our choices on the other. So, what would be the most reasonable policy expectation about the new global economy? Eliminating

the carbon gas emissions inevitably implies higher energy costs and slower growth. There is no miraculous economic boom. Green should transform itself from truism into beating reality and the economy should grow again as the demand for improving living standards will continue to manifest itself as it is today.

Connectivity between physical and social systems is a fundamental characteristic of natural risk. Hence, the representation of natural risk cannot rely on one theory or discipline alone. Indeed, it encapsulates a huge range of research fields. Acknowledging connectivity is a defining feature, and the need for a multi-disciplinary approach is crucial. The emerging new global economy is a case in point. Increasing connectivity is likely to result in higher complexity. Natural processes are complex phenomena displaying interaction with humans and their built environment. In terms of natural hazards, such as floods, tsunamis, severe droughts, landslides, the crucial questions are: How far away is the system from its internal threshold and when will the next external disturbance occur with the power of destabilizing the system?

When you can't say what a system is going to do next you are confronting a situation of unpredictability which just generates uncertainty and disorder. The moment of truth, unpredictable, can appear in the form of a drastic change, when a critical threshold is reached. Thresholds, which have to be crossed before a reaction can follow, can be assigned to internal or external factors, either embedded within the system configuration or as part of external systems influencing the natural environment system from outside. In a highly sensitive system, small external climatic triggers can foster a reaction - natural hazard- while a non or low sensitive system possesses a buffer capacity, and no or little reaction will result.

New patterns of risk and uncertainty should be analyzed and included in the new politics. Very often we have to resolve the tension between the desire for coherence and the facts and experiences of living which are almost entirely fragmentary. As a result we have difficulties in elaborating action plans. This is even more evident in the politics of today. There is no more predetermined politics; what actually happens doesn't have to happen, i.e. it is not a planned outcome.

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