In Math We Trust

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Isn't it time to review our theories on economics, to see them in a radically different light? What lessons are we learning from this and other crises, if any at all?

In the 1930 around 10000 banks have defaulted. The total amount of assets involved was equivalent to approximately 100 billion of today's dollars. In the period 2007-2009 that amount was equivalent to 7 trillion dollars. While in the 1930s the amount of assets involved per person could be valued at around 800 dollars, today the price tag is close to 20000. It appears that economists and politicians haven't learnt any lessons. We have much more technology, a more advanced math (maybe that is the problem!) and information in abundance.

Something is very wrong. Imagine, for example, that with all the computer-aided engineering technology available nowadays our motor cars are less safe, consume more fuel and are less comfortable than those of the 1930s. What would the conclusion be? What would the public say? What would engineers and designers have to say? How would they justify such an embarrassing situation? What measures would be taken?

Clearly, the situation with motor cars is not as depicted above, although certain manufacturers are packing useless gadgets and electronics into their cars, making them increasingly complex and reliant on computer chips and on electronic impulses. Looks a bit similar to derivatives and the real economy.

Things will get complex with cars when they will be driven by pressing buttons, much like today's modern airliners….

The neoliberal approach to economics – the so-called Chicago School approach of M. Friedman et.al. – sustains that the market is wise enough to reach a point of equilibrium. How valid is this theory? Well, it has laid a very solid foundation for today's global meltdown. A crisis that is planetary and that engulfs everything and everyone (if this has been intended, the theory is great). Problems with economics – and the economy – start, when you begin thinking that it can be described by mathematical formulas. Our math is good for certain things, it is not so good for other things. Our math is too "digital" and is not suited for describing many of the things we encounter in Nature. In those instances, it is better to resort to model-free methods, which don't require one to build a math model. With building models (theories) there are many issues:

- You must have a deep understanding of the nature of the problem
- You must define well the object to be modelled
- You must select a modelling strategy (linear, non-linear, deterministic, stochastic, etc.)
- You must chose a solution strategy (closed form, finite differences, finite elements, etc.)
- If a model is expensive to run you simplify it, building the so-called Reduced Order Model, sacrificing variables, making assumptions
- You must validate the model not based on one event but on many events – once is not enough
- You must be very careful to use the model only in its domain of validity, never outside

However, experience teaches that:

- Models must be relevant, not precise
- Critical parameters in a model are discovered by accident
- The most important things in a model are those it doesn't contain

If that were not enough, math is often used to model things that cannot be modelled (in the sense that the results such models produce are mathematically correct but totally irrelevant). Risk, and especially the consequences of risk, are something that math is unable to embrace. This is because risk lacks a definition, a metric (standard deviation is NOT a measure of risk) and, most importantly, because it is a reflection of subjective human sentiments as to the potential level of regret after some hazardous circumstance has actually materialized. Now how do you measure that?

The same may be said when attempts are made to model mathematically the economy or parts thereof. As reality shows, you cannot reflect the economy in a formula, or in a mathematical theory that follows a set of equations. The economy is not a system which follows the laws of physics (although some of its chunks do!). It is not an exact science (actually, no science is exact but that is another matter!). Since humans form part of the economy, the system, by definition, is impregnated (not to say dominated by) with irrational human sentiments and behavior. Theories such as the "Rational Expectations Hypothesis" and the "Efficient Market Hypothesis" are the reflection of a futile attempt to transform a "social science" into an exact science.

This can only happen on the basis of brutal assumptions and hypotheses and, as we can see today, with consequences that come at a dreadful price (the full magnitude of which still remains to be

estimated). Brownian motion, Ito integrals, Wiener processes and semi-martingales are one thing, irrational human behavior is another. Insistence is futile.

So, how can you run and govern a fuzzy, unstable, chaotic and increasingly complex system of planetary proportions that cannot be embraced by contemporary mathematics? While this does not pretend to be a complete recipe, we may do the following:

Since complexity is growing fast, and because excessive complexity is the source of fragility, we should start monitoring complexity at all scales and wherever possible:

- financial products (derivatives in particular)
- corporations
- banks
- markets
- national economies
- systems thereof

Complexity limits should be placed on all those actors that add complexity to the system making it less governable and more fragile. Two examples:

- derivatives with less than four-star resilience rating should not be allowed
- mergers of banks or corporations with less than four-star resilience rating should not be allowed

The idea is to limit drastically the complexity footprint of financial products and banks so that they don't become a threat to the system by making it fragile and ungovernable.

Complexity has two fundamental sources: structure and entropy. A richer and diversified economy has an intricate structure. However, in order to maintain that structure in a healthy state it is necessary to limit the erosive effects of entropy which tries to dissolve it. This is exactly what we do when we try to stay healthy in the face of the destructive forces of entropy (ageing, aggressive chemical agents). Limiting the intake of alcohol, sugars and fats is precisely what we need to do in our economy. Toxic financial products cannot be eliminated altogether but their toxicity may be reduced by eliminating the highly complex ones.

The toxicity of a financial product is proportional to its complexity

So, how do you run an economy that is highly turbulent, and which cannot be modelled? The answer is you cannot – this crisis provides eloquent empirical proof. The global economy has its own turbulent dynamics, which is largely unknown, and which cannot be controlled in the classical sense. You can't control it, but you can cope with it.

What you can do, though, is introduce these three fundamental pillars:

- Introduce regulations that limit the reach of finance and financial engineering. In practice, do the opposite to what Bill Clinton's "historical" 1999 Financial Modernization Act did. This could prevent a huge financial black market which may ultimately strangle the real economy.

- Limit the complexity of mergers, transactions, financial products and portfolios. If you don't, they will not only poison the system, they will make it extremely fragile and ungovernable.

- Democratize the process of rating. Ratings must be affordable, transparent and available at any time. Most importantly, they should be objective, with no conflict of interest in the process.

Adding rules – a means of passive control – creates constraints and may limit the growth of structure – a good example is the bureaucracy of the EU which is strangling the system. However, eliminating too many rules and easing regulations creates entropy, which destroys structure and makes systems inefficient.

An economy may be understood better and run without making any assumptions as to the market's wisdom and perfection, about improbable market efficiencies and equilibria. Approaching systems as complex as the economy armed with mathematics and ideas from quantum mechanics can be very damaging but it can get you the Nobel Prize at the same time. Do the needs of one outweigh the needs of the many?

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