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Science is measurement, yet not all sciences can be evaluated using the same measurement

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Abstract. *The purpose of this paper is to investigate if in Economics may take place the same type of "Darwinian Competition" that occurs in Natural Sciences and through which theories are permanently removed. Starting from how measurement, tool development and the establishment of the experiment as a research method, led to significant progress in natural science we demonstrate that the same assumptions for reducing the complexity of reality and the ontological universalism hypothesis cannot be used in Economics. The consequence of not being able to use the same methodological tools is that economics has to be content with the use of statistical laws, which merely allow the prediction of "empirical regularities" in comparison with the precision of natural sciences laws.*

Keywords: equilibrium, experiment, measurement, ontological universalism, Darwinian Competition.

JEL Classification: B41, C62, N01.

Introduction

For most of us, the word science is associated with that kind of knowledge, which although it is subject to the ethos vagaries, it remains objective and that objectivity is arising from rational argumentation. The kind of knowledge that explains the relationships between things, objects or people and not the thing itself or even less the individual itself. Although when it comes to relational knowledge, in a representational meaning it can be subjective. The current scientific paradigm is concerned only with that kind of knowledge that can be repeated and transmitted to others beyond the sensory or mental perceptions of each individual. Also, we are looking at the accuracy with which scientists succeed in explaining these relations, the causal relationships among phenomenon and try to explain which is the cause and which is the effect. Finally, we come to classify or better said, to give value to a science by its ability to explain, using theories through an abstract model, the reality. And this inevitably leads us to divide the science into narrower domains. Even if the dream of any great scientist is to find the unifying theory and even if the studied issues can easily cross the artificial boundaries that we have imposed to each field, the method of partial explanation of reality had and still has a heuristic value. But what happens if theories which partly explain reality are not compatible with each other? According to this situation, one may question our capacity to select the relevant facts required for the phenomenon explanation.

This very specific problem can be observed even in Physics, the most organized factual science. Physics is currently explaining reality using two totally different and incompatible theories. General relativity explains the order at a cosmic level and quantum mechanics explains the disorder at the subatomic level. Both explain very well what is happening in their field of study (Macroscopic World and Microscopic World), however the functions of spatial geometry of general relativity theory collapses when observed for extremely small distances because of the violent fluctuations of the particles (which are explained through quantum theory). How can that be? How can there be order at macroscopic level and chaos at microscopic level and how can order be generated from disorder? How can both theories be “true” and should antinomy exist in a theoretical science?

This paper has a more humble purpose than that of finding a unifying theory of physics. In this paper, I will try to explain the difference of measurement performed in social and natural sciences. I will explain in what sense, social sciences are more complex than natural sciences and therefore would require a more sophisticated epistemology. This complexity is mainly due to exogenous variables as well as descriptors of general logic with which every explanatory model operates. At the same time, I will demonstrate how the tools development, at a higher pace in natural sciences, has brought significant progress in comparison with the social sciences. Tools development and more accurate observation of the phenomenon are the main causes for the *Darwinian Competition* between theories in natural sciences. This type of competition is a major source of progress for the theory of knowledge. On the other hand, identical competition in social science does not exist only because of inadequacy or insufficiency of instruments but mainly because of the specificity of the studied subject, which contains by nature, indeterminist elements such as free will, motivation, value judgments and all of these represent primary causes of human action, making some theories to become immortal.

Literature review

Any article that aims to make explicit the role of different measurements and how they are used according to scientific fields must start from a theorizing model. The model that could lead to the Darwinian competition and that natural science uses to enrich the theory of knowledge is the critical rationalism proposed by Karl Popper and also used by Goodman and Snyder (1993, pp. 338-350). This way of theorizing divides scientific claims into two categories. The first category is constituted from theories with empirical content, which may therefore be subject to falsifications by observation and measurement. If the theories withstand the tests, they will still be maintained and if they are counterfeit they will be repudiated. The second category is that of non-falsifiable theories, non-empirical theories, which cannot be tested. Economic science has theories contained in both categories. Into the non-testable theories category fall most of the normative theories. Normative theories are determined primarily, and this is a great deficiency in terms of measurement, by the link with the past and to what is socially acceptable in the current period. History, tradition, culture and even religion in many societies play an important role in the formulation of normative theories. How can we measure, for example, if a country is democratic or not? Moreover, how can we measure the optimum to which the individual freedoms or the constraints imposed by the government should extend?

The search for precision in measurement and the transpose of certain statements such as *"a single number has more real and permanent value than a vast library of hypotheses*" Robert Mayer(1) (Georgescu-Roegen, 2009, p. 15) have pushed economics to the belief that everything can be measured. The fascination exerted on the intellect by the number can be traced back in time to the ancient Greeks; it is not easy to overcome even today. This is the fascination that has produced the ***ordinal illusion*** and whether there are numbers, there must be "more" and "less" and therefore ***Quantity.*** This type of reasoning has driven some authors, such as Stanley Jevons to assert that *"since the Economics deals with quantity, it must be a mechanic of utility and self-interest."* (Jevons, 1965, p. 50). Those economists have built a bridge between physics and economics and began adopting the methodological tools, in terms of measuring variables, with the risk of eliminating certain important assumptions. This toolkit also eliminates a second very important part of establishing scientific knowledge in physics, namely experiment.

Economics cannot perform controlled experiments, and when they perform them, the subjects do not behave in the way they would behave when they are not observed (the same problem appears in quantum physics). I will return to the issue of the experiment and the place it should occupy in Economics and also to the differences between precision laws and statistical laws. One of the most important assumptions that Physics makes when performing measurements on Earth and which, Economics have borrowed (which leads to erroneous generalizations and economic policies) is the ***Ontological Universalism***.

The Ontological Universalism hypothesis and the Social Constructs

This assumption plays a crucial role in determining a theory generality degree. Following Popperian criteria, a theory is more valuable as it forbids more effects to take place. In this case a theory is most valuable if it does not allow exceptions from the general rule. In Physics a theory that explains the physical world in which we live, must be valid for any place and time on Earth. An oxygen atom will have the same behavior in a rich country in Northern Europe as well as in a poor country in Central Africa. By contrast, human societies differ in space and time. The main categories that we can find in the literature for classifying the human societies are as follow: primitive collectivism, feudalism, capitalism and communism. Economics must use some domain specific assumptions in conjuring with the ones used by Physics (to determine the factors that create these different types of societies). If we assume that the key factors in shaping social relations are institutions and technology, and these types of societies have different technologies and institutions, we will need a theory relating to each type of society. Economics call for Ontological universalism leads in most cases to paralogism and errors characteristic of inductive logic, a recent and well argued case are austerity policies (Blyth, 2015).

Identification of observable variables is not an easy task for Economics, but one that requires a measurability criterion. Such a criterion was proposed by the philosopher John Searle (1995, pp. 35-56); propositions about facts can be classified into two categories: Ontological and cognitive and each category can be either objective or subjective. Sentences that relate to physical objects are ontologically objectives and those relating to mental constructs are ontologically subjective. Moreover, sentences about things that have meaning independent of the observer (or do not need a point of view) fall into the category of cognitive objectives, and those who need an observer (a particular point of view) in order to make sense, fall into the category of subjective cognitive. In Economics sentences that fall into the category of cognitive objective are positive, while those that fall within the cognitive subjective are normative. We can now create a matrix of measurability that can frame any sentence and it will have two meanings; one will be ontological and the other will be cognitive.

Different types of reality matrix based on the classification criterion of John Searle

Ontological	**Cognitive**	
	Objective (positive)	**Subjective (Normative)**
Objective (physical)	(1) This paper has a width of 2 millimeters	(2) I don't like thin paper
Subjective (mental construct)	(3) The money supply has increased	(4) I like money

Measuring a piece of paper is both ontological and cognitive objective therefore should be placed in box no. 1 of this matrix, but someone's feelings on the paper thickness should be placed in box no. 2. On the other hand, money (paper) is ontologically subjective because they are socially constructed and are socially accepted as a mean of exchange. At the same time money is cognitively objective, is not required a viewpoint of someone to recognize a 5 euro bill, so it should be put in box no. 3. Sentences that describe our feelings about money will be both ontological and cognitive subjective and will fit in box no. 4.

Physics and Biology are using as observable variables only those that fall in box no. 1. Economics is using such variables as well; take for example, the agricultural or industrial production. Beside this category, Economics is using observable variables that should fit in box no. 3; a good example would be "the money supply has grown in the last year". Because Economics is using social constructs, the complexity of the variables is increasing. We didn't chose money for example by chance, but because there are different types of notes and not every one of them are accepted in any country in the world. Not everyone can recognize a 5 RON bill. More people can recognize the 5 euro bill, but anyone can recognize that measures of the paper on which the banknotes are printed.

In these circumstances we can conclude that much of the progress of the natural sciences is due to the facts and variables used in measurements. Another portion of the progress is due to the innovation in measuring instrument. Microscopes, telescopes, spectroscopes, all have registered accelerated progress. We can argue that major paradigm shift in physics were made by instruments. New tools have led to new observations which overthrew the previous paradigm. This assumption is contrary to that proposed by Thomas Kuhn (2008, p. 61), who argues that the main reasons for paradigm shifts are new social and political ideas. Moreover, we must understand the shortcomings of observations in Economics. Data which economists typically use in their predictions are either official government statistics or data from surveys applied to the companies or households. In this situation a problem may arise regarding the objectivity of such data, a problem generated by the *self-interest.* If we admit the assumption of Adam Smith, who ranks self-interest as the main stimulus for human action, then we must admit that this self-interest is maintained by firms and households when providing information. In producing a public good such as information, incentives to households or firms are not in favor of the production of "true" information in the sense of objective, but rather inclined to produce "correct" information in terms of political or cultural. In the case of government, if we accept the assumption that argues that the government primary interest is to maximize the number of votes, we have even a more acute problem than for households or firms. Motivation is again changed from producing the "true" information in producing the "politically correct" information that has the greatest potential to attract votes.

The role of the experiment as a research method and the differences between precision laws and statistical laws

It is important to understand that theorizing in both natural and social sciences is consistent with the mainstream worldview. Until recently the undisputed mainstream worldview, starting with Galileo and Newton was that of mechanical physics. Nowadays the mainstream is challenged by the vision of quantum physics. We can say that we are at a crossroads of paradigms. What I want to emphasize is that "scientific objectivity" cannot escape the contextual chains and in the context of mechanics, the veracity of a theory is given by the ability to pass the test of falsification. The falsification is usually tried through experiment and often in couple with mathematics. Even the greatest philosophers have failed to escape the chains of context, and in this respect we can see

even I. Kant sinning when he said that *"in any field of the natural sciences there is only that much science as much as mathematics is included in it"* (Kant, 2004, p. 6). Kant believed that the criterion of science is mathematics and eventually all the natural sciences will take a mathematical form. Even if this belief led many of his followers to an overvaluation of mathematics, some even to panmatematism, Kant's belief was invalidated by the history of science, at least until today. However, from these beliefs some questions have arisen and these questions need answers:

1. Can the experiment be used as a research method for testing theories in social sciences?
2. Can we inquire the empirical observations using the same type of laws (precision) used in the natural science?

First, in order to use the experiment as a research method it is mandatory to operate some complexity reductions. For the natural sciences there are several categories upon which such reductions must be used, as argued by Lucian Blaga (1998, pp. 218-219):

a) External conditions.
b) Conditions related to the experimental equipment.
c) Conditions related to the observation process of the phenomenon regarding the experimenter.

One will ignore both external conditions of the phenomenon and the intrinsic conditions of the equipment because by their nature they are considered to be "constants". The same applies to conditions pertaining to the observer because it is considered that his influence on the experiment is negligible. Experiments of mechanical physics conducted under the light of these reductions have greatly contributed to the theory of knowledge. On the other hand, experiments subject to these reductions cannot occur in quantum physics. The main reason for which these reductions cannot take place is the order of magnitude, which is similar to the size of the observed variables. Just by observing the phenomena, the observer will have a significant influence on the observed variables; in most cases he will alter their behavior.

Regarding social sciences and especially economics, using the experiment as a method of testing the theory, will require the use of an auxiliary reduction beside those mentioned earlier. It is considered that the behavior of the observed subjects (humans) is rational. This hypothesis gives birth to a series of problems. Firstly, there is no consensus regarding the concept of rational behavior. Rationality can be defined as the behavior that leads to the objective in the most efficient manner (i.e., economic rationality, efficient use of resources). In Economics we often encounter rationality defined as a set of preferences or decisions that are inwardly non-contradictory and mutually consistent. But for these assumptions widely applied in economic theory, psychologist Daniel Kahneman, Nobel Prize winner in Economics sounded the alarm saying that *"Defining rationality as consistency is too restrictive; it calls for an adherence to the rules of logic that a finite mind is not able to apply"* (Kaneman, 2012, p. 637). Moreover, this "straitjacket" imposed by rationality consistency should not be worn again, because goals can change depending on the emergence of new information, as Keynes argued in the past century.

Thus, decisions to achieve new goals may be inconsistent with decisions taken to achieve the initial objective.

To answer the above questions one must understand that experiment, as a research method, unfold by deterministic laws (the experiment is by definition a controlled process). This very process control enables us to isolate the phenomenon we wish to study. By isolating the phenomenon under laboratory conditions it is understood, that in the natural sciences, the initial conditions can be reproduced. This is possible because of the "inanimate matter" that those sciences are studying. The experiment results will be identical; the process through which one can go from cause to effect will be the same, if we submit the studied object to the same initial conditions, thus allowing us to extract some **precision laws.** Using the experiment as a research method leads to a conclusion regarding empiricism and has an epistemic consequence, namely, **it is transforming the empirical observation into the ultimate source of scientific knowledge**. On the other hand, this phenomenon isolation and reproduction of the initial conditions cannot be operated in the social sciences. First because the subject of study (human) who can act or react differently under identical conditions. Secondly, there is only one sense of the knowledge accumulation which makes it impossible to reproduce the initial conditions and deems useless the historical comparison, so although we say that history repeats itself, it is merely an approximation, we have no historical laws, a good argumentation of this idea can be found in *The poverty of historicism* by Karl Popper. Moreover, there is a certain degree of indeterminism in an evolutionary process. History is contingent mainly because innovation which disrupts systemic regularities and assures us that the world is non-ergodic, that *"it is more than a statistical shadow of the past"* (North, 2005, pp. 44-45).

We should now have a pretty clear picture of the position of the experiment in Economics and that social reality does not support precision laws. The only laws that the experiment can justify are **statistical** or otherwise, **empirical regularities**. We must be very cautious with respect to the dangers that the experiment method can pose. One that commonly occurs is that in the absence of additional explanations "empirical regularities" create false certainties. Most economic crises are based on an erroneous assessment of risks caused by these false certainties.

The evolutionary process and the logic of scientific research

Before we explain how the evolutionary process works (or doesn't) in Economics, we have to define the framework within which this science operates, namely the society. To characterize a system as static, dynamic and evolving we have to look at how the equilibrium is achieved in that system:

- Static equilibrium assumes repeating the same values of endogenous variable, period after period, as long as the values of exogenous variables remain the same.
- Dynamic equilibrium assumes a particular path in time for the endogenous variable as long as the values of the exogenous variables remain the same.

An evolutionary process, be it an economic process, assume that equilibrium values of endogenous variables cannot be repeated indefinitely, sooner or later this iteration will be interrupted. This interruption will move the system into a new process which differs qualitatively from the old process. A good example of such a process would be a society in dynamic equilibrium in which the total income increases, but also the inequalities. As this process is repeated, the degree of inequality worsens to such an extent that it reaches a boiling point; it produces a social crisis, which historically leads to violent redistributive processes, i.e. revolution. Economic theories assume evolutionary processes; only through them the qualitative changes of society can be explained.

Even if we admit the existence of evolutionary processes in Economics we should further investigate whether this leads to the "Darwinian Competition". In the natural sciences this investigation is done according to the Popperian criteria of falsification, propositions are tested empirically. This criterion is not enough for social science, implicitly nor for Economics, because many assertions cannot be directly empirically tested. Thus we need an additional criterion, such as the one proposed by Nicholas Georgescu-Roegen (2009, p. 56).

By logical sorting, assertions can be divided into two categories:
1. Any β proposition is a logical consequence of an α proposition.
2. No α proposition flows from another α proposition.

An α sentence should not be directly observable or tautological, but at the same time it should allow logical derivation of β sentences, which in turn are observable and therefore testable. In other words, α proposition is the theory and β propositions are the theories' testable predictions. If no β propositions can be logically derived from a "theory" then that is not a scientific theory. This method proposed by Georgescu-Roegen is very important due to the fact that it establish causal relationships between variables. The variables are not intrinsically endogenous or exogenous; they are classified in those two categories only in the light of scientific theories. Moreover, in Economics the same variable can be considered as endogenous in one explanatory model and as exogenous in other explanatory model. We must admit that Economics is a science of aggregates, a science dealing with the society and not the individual, in short is a science of averages or at least that's what the representative agent does. In these circumstances testing and falsifying theories is done via statistical methods. It should not surprise us that Economics operates with empirical regularities, even so, one must inquire the consequences of this procedure.

Adolfo Figueroa argues that a theory is composed from a family of models. *"To derive a β proposition from an economic theory we need a* "social situation" *in which the social context and the constraints under which the social actors operate are determined"* (Figueroa, 2016, pp. 55-57). But to create this context, in order for theories to be operational, it is required to introduce some auxiliary hypotheses. Since there are different social contexts, and for each context a different set of auxiliary assumptions is used, we will end up by having a model for each context. All possible models (the number of different social situation must be finite), are composing the theory. Testing the theory is done now indirectly, by testing each model. If a model of that family is falsified,

then the model is rejected, but not the theory. The process moves to the next model and the theory will be rejected only when all the models of that family will be falsified. On the one hand I must stress that this method proposed by Adolfo Figueroa is prone to the so-called Duhem-Quine problem, who claim that using auxiliary hypotheses creates a kind of protective ring around theories so they are saved from falsification. On the other hand, this method explains quite well how theories which are composed by empirically falsified models are returning again as "fashionable".

Conclusion

As the article demonstrates the particularities of the studied subject of Economics require the adoption of looser hypotheses, which involves giving up many of the exaggerated claims about forecast of human behavior. Tools that can quantify elements so important to increase the accuracy of the forecasts were not invented. Elements such as: will, judgment, motivation, etc. are impulse – causes of human action. All of them are components of the human nature and can vary from individual to individual.

The most important conclusion that emerges from this article is that, beyond the objectivity of scientific theories we must always remain aware that they operate with humans endowed with free will. Using Searle's matrix, one can observe that most economic theories fall within the ontological subjective. The consequence of this is that theories responding to psychological needs will always get a *veto* on those theories that do not answer such needs. This is the main reason why theories such Austerity or Trickle-Down Economics still exist even though they had most of their models empirically refuted. This is the textbook demonstration of what Mark Blyth (2015, p. 46) claims as *"facts never contradict a good ideology"* and the main reason why we can't have that type of "Darwinian Competition" in Economics.

Theories such as Marxism or the self-regulated free markets proposed by the *"Chicago School"* for Latin America have not been falsified because the model could not be built respecting the hypothesis form the textbook. The main reason why they were not respected is that they could not be imposed on the population that would have to bear the model (not even in a totalitarian regime, not to mention in a democratic regime, where these assumptions are utopian or better said dystopian).

Therefore, a question remains open: In this context, should Economics, through its so-called scientific objectivity, raise claims over those accepted in a democratic manner? In my opinion, we are walking on a dangerous road if we are ready to accept and impose theories to human subjects justified only by using the same theoretical framework we use in natural sciences.

Note

(1) The statement is out of context; Robert Mayer was speaking to a group of physicists and he didn't need to add further the condition that that number must correctly express the reality.

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