



# **Theory of Relativity : Some Perspectives**

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**TAPMI WORKING PAPER SERIES NO. 2005 / 12**

The objective of TAPMI working paper series is to help faculty members of TAPMI to test out their research ideas/findings at the pre-publication stage.



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## Abstract

Einstein shows how Euclidean Geometry (EG) fails to represent the reality. As a paradigm, EG believes that the axioms are true. He proposes theory of relativity as an alternative to EG. The relativity perspective has relevance in social sciences like economics, particularly in the context of on going discourse on reality. By reflecting on Einstein's views, this essay seeks cues for further investigation on the link between research and reality.

**Keywords:** Euclidean Geometry, Theory of Relativity, Reality

## 1. Introduction

This essay reflects on relativity theory, and explores its relevance in research. Discussion, carried out here, is based Einstein's monograph entitled 'Relativity: The Special and General Theory'. Einstein begins by reflecting on the Euclidean Geometry (EG), which believes in certainty of knowledge (Einstein, 1916)<sup>1</sup>. Such faith seems to have impact on traditional social science research<sup>2</sup>. In economics, EG type models are often used for predicting human behaviour in relation to different activities like production, consumption, distribution and exchange<sup>3</sup>. For instance, individuals are assumed rational in most of the Neo Classical economic models. However, emerging perspectives question the link between the axioms and the reality. According to critics, axioms being rational

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<sup>1</sup> This belief presupposes that there is correspondence between the logic and reality. This relation is believed to be independent of time.

<sup>2</sup> For instance, the partial equilibrium metaphor in Neo-Classical Economics is deeply rooted in Euclidean Geometry.

<sup>3</sup> These models are axiomatic in nature.

choice are far off reality<sup>4</sup>. Einstein's relativity theory can play vital role in exploring the current debate on reality in disciplines like economics.

The essay contains 4 sections. Section 2 examines Einstein's critique of EG. Einstein's interpretation of Galilean System of Coordinates is discussed in section 3. An overview of Theory of Relativity is given in section 4. In section 5, we link the relativity perspective with the economics. Section 6 contains conclusive remarks.

## **2. Einstein's Reflection on EG**

Einstein (1915), in the beginning of his work, addresses what a reader thinks about the absolute truth. He shows how the EG is viewed by people. As reflected by him, EG is founded on a few propositions (axioms), which are often considered as truth. For instance, most of us think concepts like plane, point and straight line are true. Based on this truth, we often construct theorems. Einstein shows how the geometrical propositions are derived from the axioms. For example, In EG, straight lines are those things, which are defined by two points situated on them<sup>5</sup>. Einstein expresses (1916, p 6):

“Geometry sets out from certain conceptions such as plane, point and straight line, with which we are able to associate more or less definite ideas, and from certain simple propositions (axioms) which, in virtue of these ideas, we are inclined to accept as true.”

Above quotation shows the link between conventional wisdom and truth. In this context, axioms lead to geometrical propositions. A major consequence of this process is that axioms subsume geometrical propositions. This perspective resembles the School of Logicism, which views that (some or all of) the mathematics can be reduced to formal logic. In other words, the mathematics is a proper subset of the logic. Validity of such a model depends upon how meaningful the axioms are. For example, in EG a straight line exists between two points. However, the definition of a point itself is meaningless and far

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<sup>4</sup> For example, axiom of transitivity

<sup>5</sup> A straight line is one, which lies evenly with the points on itself.

from reality<sup>6</sup>. On reflecting how the EG paradigm views reality, Einstein expresses (1916, p7):

“In less exact terms we can express this by saying that by the truth of a geometrical proposition in this sense we understand its validity for a construction with rule and compasses.”

Einstein seems to take a constructionist stance, where in, he says that reality is different from EG version of ‘truth’. However, he interprets that EG has an objectivist approach. If we consider this idea in the frame of “Me, Model and Reality”, EG is not grounded in reality<sup>7</sup>.

### 3. Principle of Relativity

Later, Einstein transcends from Cartesian coordinates to Galilean coordinates and explains the Principle of Relativity in Restricted Sense<sup>8</sup>. According to this principle, the trajectory or path, followed by a rigid body or its velocity, changes with the *frame of Reference*. Frame of Reference, in simple words, is the space from which the observer is observing. For example, consider a person traveling in a train (frame of reference is the train carriage) and another standing on the embankment (frame of reference is the embankment). Suppose a stone is dropped from the train, to the person in the train, the path taken by the stone looks like a straight line. However, a bystander on the embankment views it like a parabola. Einstein uses this example for illustrating the theory of relativity. He states (1916, p 15),

“If K is a Galilean co-ordinate system, then every other coordinate system K' is a Galilean one, when, in relation to K, it is in a condition of uniform motion of translation. Relative to K1 the mechanical laws of Galilei-

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<sup>6</sup> In EG, a point is that of which there is no part.

<sup>7</sup> By ‘Me, Model, Reality’, we mean the way we look at reality (known as *ontology*). For example, sometimes scholars say we think objectively, or some state we are constructionist (see Crotty, 1998).

<sup>8</sup> Cartesian coordinates describe the position of an object in a frame of reference, which obeys EG. Galilean coordinates describe a point on a rigid body with respect to the frame of reference attached to the rigid body, and law of inertia holds well in this frame.

Newton hold good exactly as they do with respect to K... If relative to K, K1 is a uniformly moving co-ordinate system devoid of rotation, then natural phenomena run the course with respect to K1 according to exactly the same general laws as with respect to K. This statement is called the principle of relativity (in the restricted sense)”

When the principle of relativity is extrapolated to the frame of reference in which light travels, the *Law of Propagation of Light* may not hold good. This situation arises due to the *theorem of addition of velocities*<sup>9</sup>. In order to explain this phenomenon, Einstein developed the *Special Theory of Relativity*.

According to Einstein (1916, p 21),

“At this juncture the theory entered the arena. As a result of an analysis of the physical conceptions of time and space, it became evident that in reality there is not the least incompatibility between the principle of relativity and the law of propagation of light, and that by systematically holding fast both these laws a logically rigid theory could be arrived at. This theory has been called the special theory of relativity to distinguish it from the extended theory...”

There seems to be significant degree of closeness between reality and relativity perspective. For example, a person is identified as good or bad, often based on the received view in the system she exists in. There is no absolute truth that she is good or bad. Rather, there is a degree of belief in saying what she is. Degree of belief can also be interpreted as chances of how she appears to others.

#### **4. Relativity and Reality: A Case of Economics**

In social science research, the reality is gaining importance as a criterion of scientific progress (Lawson, 1997). Evolution of such a criterion has links with different schools in philosophy of science, which argue that the knowledge production is a historic, social, and behavioural activity (Kuhn, 1970, Lakatos, 1970, Feyrabend, 1975). Another major departure from ‘absolute and certain truth’ is the critique of ‘homo economicus’ models

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<sup>9</sup> According to the theorem of addition of velocities, if a person is moving with velocity  $W$ , in a train that is moving with a velocity  $V$ , then the velocity of the person relative to the stationary platform is  $W+V$

by bounded rationality school (Simon, 1986, Gerd & Peter, 1999). According to Gerd and Peter (1999), a bounded rational individual does not maximize the benefits in contrast to the assumption in Neoclassical Economic Models that the agents are unbounded rational. They show the individuals take decision by using heuristics. The cues for ‘heuristics’ are interestingly drawn from Einstein. Gerd & Peter express (1999, p 25-26):

“In 1905, the 26-year-old Albert Einstein published his first fundamental paper in quantum physics, titled “On a heuristic point of view concerning the generation and transformation and light.” In that Nobel prize winning paper, Einstein used the term “heuristic” to indicate that he considered the view he presented therein as incomplete, false even, but still useful. Einstein could not wholeheartedly accept the quantum view of light that he started to develop in this paper, but he believed that it was of great transitory use on the way to building a more correct theory. As used by Einstein, then, a heuristic is an approach to a problem that is necessarily incomplete given the knowledge available, and hence unavoidably false, but which is useful nonetheless for guiding thinking in appropriate directions”

Economics is the leading knowledge producer among social sciences. It may be noted that one fourth of social science publications and one third of citations are from economics (Ingwersen et al, 2001). However, it is in crisis, and it is a good example for the phenomenon of institutional oligopoly (Hodgson & Rothman, 1999). Institutional order in economics (i.e hierarchy of Universities and Journals) has been stable during last five decades. It coexists with the orthodoxy of the dominant scientific research programme ‘Neo-Classical Economics’. Neo-Classical models are based on the rational ‘homo economicus’ (i.e. rational human being). A few scholars, within and outside this lineage, questioned, if the assumption of rationality is far off human behaviour. One such debate is Simon’s critique of Becker’s theory of Family (Simon, 1986). Not surprisingly, the neoclassical models, as shown by Blaug (1980), do not meet the criteria of scientific progress. There were occasions when the challenges were met with aggressive defense. An important one was that a theory with irrelevant assumptions is good if the prediction is valid (Friedman, 1953). However, the neoclassical models are not quite known for accurate predictions (Lawson, 2001).

Even though, the mainstream (i.e neo-classical) economists have perfect agents in their models, they themselves tend to make grave mistakes. Editors and referees (most of them are top neo-classical economists) often neglect the quality of ideas in article (Ellison, 2002). There are instances when the articles containing path breaking ideas are turned down by the well known journals (Gans & Shepherd, 1994). They began to prefer formalism over quality of ideas. However, a few rejected papers made big fortunes later. George Akerloaf, who won Nobel Prize, is a classic case for such phenomenon. It seems the days of formalism are numbered. Critics have convincing reasons to say ‘mathematization is rather a regress than a progress’ (Beed & Kane, 1991). The trade-off between quality of idea and formalism may be the result of survival instincts of older generation, who are afraid of obsolescence of own research. Frey (2003) shows how academic prostitution evolves in response to scarcity of publication opportunities. Some of the authors, according to Frey, are born or learned academic prostitutes, who learn likes and dislikes of referees and editors (also see Earl, 1983). The search for publication opportunities involves uncertainty. There is chance of acceptance or rejection. To counter uncertainty, authors take cues from environment. There are cues like doctoral qualification from top order institutions, preferences of editor and referees, proportion of mathematics in paper, etc. Many authors stop search at some point. This may be a situation of ecological rationality.

The evolving forces seem to affect the tenacious institutional order in economics. Sensing the forces of change, Thaler (2000) puts “I am predicting that Homo Economicus will evolve into Homo sapiens”. What he means is that omniscient agent in neoclassical model will begin losing IQ. Thaler foresees process modeling will play in significant role economic theorization of decisions (p 137):

“There are an enormous number of ways in which a better understanding of human cognition can help us do better economics.”

Another major source of change is recent popularity of evolutionary economics. There is an apparent distinction between neoclassical and evolutionary approaches. Modeling is an important source of distinction. For instance, characteristics like assumption of



bounded rationality, use of dynamic equation, interdisciplinary dialogue etc. explain the distinction (Nelson & Winter, 2002).

## **5. Conclusion**

We attempted to show how the thought process of a genius, like Einstein, can be helpful in linking the research and reality. Although faith on absolute truth has a critical role in different human activities, essentially pure faith is at many times not based on logic. One needs to go beyond what seems obvious and reason the same to gain a wider perspective. There are a lot of essentials and concepts, which are accepted to be true (faith) and absolute by us. The essence lies in exploring the truth and appreciating the relative nature of these concepts.

As we further delve in to this masterpiece of Einstein, we hope some patterns emerge and give a sense of direction to our research. Einstein also mentions in his book that his theory of relativity will be helpful to any one who wishes to develop any law which is in general nature and is applicable across different frames of references. So, we think that further exploration of theory of relativity may help us in building a model for decision makers in the field of management which makes them sensitive to different aspects of reality. Further in the book Einstein goes on to prove that it is time and distance, and not the velocity, which changes according to the frames of reference, this forms the root of the *Special theory of Relativity*.

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