Economic Graphical Modeling from 2-Dimensional Graphs to Multi-Dimensional Graphs

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Abstract

This paper is interested to show the limitations that the 2-Dimensional and 3-Dimensional graphs are showing when we try to visualize the behavior of large number of variables, equations and functions in the same graphical space. Therefore, we suggest the application of multi-dimensional graphs under the application of Econographicology. The Econographicology is available to offer a large number of multi-dimensional graphs to economists, academics and policy makers to observe the behavior of a large number of variables, equations and functions in the same graphical space.

Since economists and academics start to use graphs to visualize the behavior of simple (static) or complex (dynamic) economic data in different periods of time in the same graphical space. The most common graphs applied on the economic analysis are the 2-Dimensional graphs to visualize historical data, micro-macroeconomics theories and final results from econometrics models. For example, the graphical visualization of any economic variable behavior such as the G.D.P. rates, inflation rates, exports/imports, etc… It is based on the application of the 2-Dimensional graphs. Usually, economists always try to interpret a group of points located in different places into the first quadrant of the 2-Dimensional Cartesian plane into a fixed period of time. All these points are connected by strait lines to visualize the historical trends from the past until today or possible results from forecasting models. Additionally, this research paper try to find some reasons about **"WHY"** economists continue using 2-Dimensional graphs and 3-Dimensional graphs in the graphical visualization of a group of variables behavior, these reasons are following by:

1. The 2-Dimensional graph modeling is established for long time, since the introduction of the 2-Dimensional Cartesian plane by Descartes until today. The application of 2-Dimensional graphs in the economic graphical analysis became by **"Tradition"**.

2. The 2-Dimensional space is **"easy to apply"** for visualize basic trends or values in the same graphical space. According to our research through 5,000 documents (JSTOR and DIRECT SCIENCES -ELSEVIER-, 2008) were selected by random from different reputable journals and text books in economics, econometrics, business, statistic, mathematic and sciences. The 99.50 % of all these documents were used 2-Dimensional graphs and only 0.05% was used 3-Dimensional graphs. The logic explanation about the common uses of the 2-Dimensional graphs, it can be originated by the easy way to plot and draw and visualize any economic variable(s) behavior. Therefore, 2-dimensional graphs can generate a clear visual and mental refraction to understand a group of variables behavior in the same space and time.

3. Difficulty to find **" alternative and suitable multi-dimensional graphical models"** to generate the transition from 2-Dimensional space graphical modeling to Multi-dimensional graphical modeling. This research paper found some difficulties to generate this crucial visual and mental transition from 2-Dimensional graphs to Multi-dimensional graphs. It can be by some difficulties in the process to plot, draw and visualization of new type of graphs.

On the other hand, the main proposition of this research paper is that the 2-Dimensional and 3-Dimensional graphs are not available to catch up the behavior of large number of economic variables simultaneously in the same graphical space. We can observe that in complex behavior of a group of variables always they are changing constantly and unlimited all the time. To test this proposition, this research paper concern that multi-dimensional graphs can show "**n**" number of economic variables behavior into the same graphical space. Moreover, the idea about space and time in the case of multi-dimensional graphs is totally different from the 2-Dimensional or 3-Dimensional graphs, because the 2-Dimensional or 3-Dimensional graphs is only available to show graphically a micro-slice of the behavior of a serial of economic variables, equations and functions on the first quadrant on the Cartesian plane.

The Multi-Dimensional (MD) graphs in the process to visualize the behavior of a group of variables through a period of time in the same graphical space. Therefore, this paper will suggest the review of the **"n-Dimensional Space"** to support the uses of MD graphs in economics. The initial idea about n-dimensional space was originated by Greeks thinkers, philosophers and mathematians such as Socrates, Plato, Heraclitus and Euclid (father of the geometry). The great contribution of Euclid in geometry was the design of the plane geometry under the 2-Dimensional Euclidean geometry and the solid geometry under the 3-Dimensional Euclidean geometry.

However, the n-dimensional space can be defined as a mental refraction through the optical visualization and brain stimulation by several lines in a logic order by length, width, height and colors to represent the behavior of simple or complex behavior of a group of economic variables, equations and functions in different periods of time in the same graphical space. The study of n-dimensional space can be classified by 2-Dimensional space, 3-Dimensional and MD-graphs. Usually, the study of n-dimensional space is based on the application of the "coordinate system". The role of coordinate system is crucial in the analysis of n-dimensional space because it can show clearly the location and interaction between two or more variables: Exogenous variable (s) and Endogenous variable (s) on the same graphical space.

It is perhaps fitting to mention here that the 2-Dimensional Cartesian coordinate system was introduced in 1637 by René Descartes (Lafleur, 1960), whose contributions to different scientific disciplines, of which economics was one, were substantial. The 2-Dimensional Cartesian coordinate system opened a new era in economic analysis by providing for the analysis of a single economic phenomenon. In fact, the 2-Dimensional Cartesian coordinate system is available to visualize the relationship between the exogenous variable (under the vertical axis = Y-coordinate) and the endogenous variable (under the horizontal axis = X-coordinate) in the first quadrant in the Cartesian coordinate system (See Figure 1). Or the observation of the trend of a single economic variable (e.g. exports, imports, unemployment, GDP, inflation rate etc.) within a time frame (per decade, annually, monthly, weekly or daily), it is based on the uses of histograms, line graphs and scatter-plots. In the case of 3-Dimensional Cartesian coordinate system (X,Y,Z) support the construction of surfaces and 3-D manifolds, it is based on the uses of three coordinate system follow by "X-coordinate" (or exogenous variable), "Y-coordinate" (or

exogenous variable) and the "Z-coordinate" (or endogenous variable). Usually, the 3-Dimensional Cartesian coordinate system work under the Euclidean geometry theoretical framework. The main objective of the 3-Dimensions Cartesian coordinate system (See Figure 1) in economics is to study the behavior of two exogenous variables (X,Y) can affect directly on the endogenous variable (Z).

Figure 1
2-Dimensional and 3-Dimensional Graphical Modeling
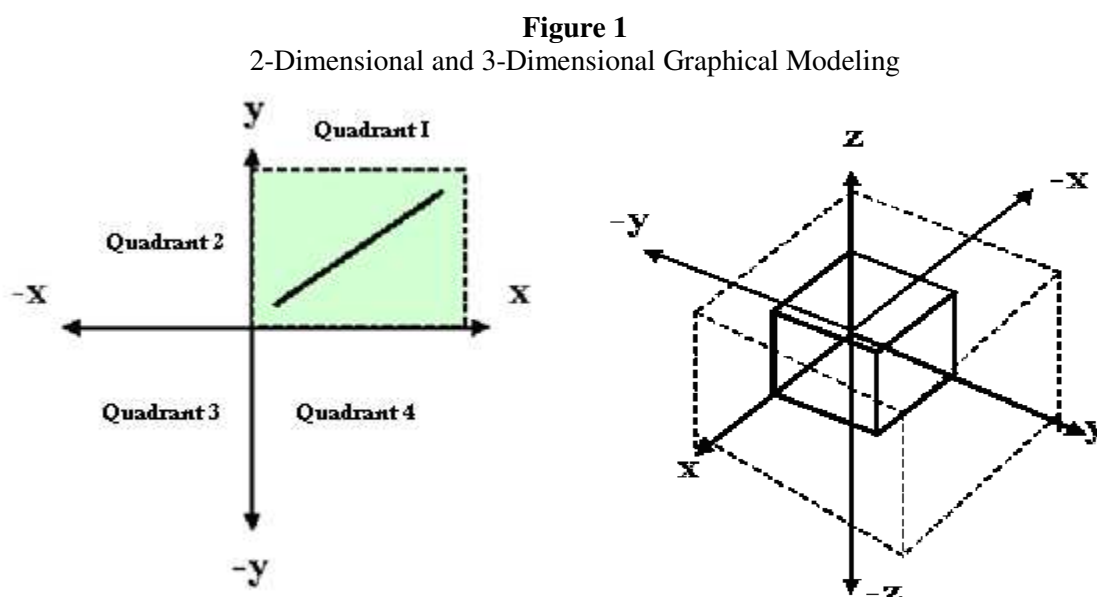
Finally, the construction of Multi-dimensional graphs is based on the traditional 3-Dimensional space concept, but they can represent 4-Dimensional, 5-Dimensional, 8-Dimensional, 9-Dimensional until Infinity-Dimensional spaces. The Multi-Dimensional graphs can facilitate the easy understanding of complex economic phenomena under the visualization of large amount of exogenous variables can affect directly on the endogenous variable (s).
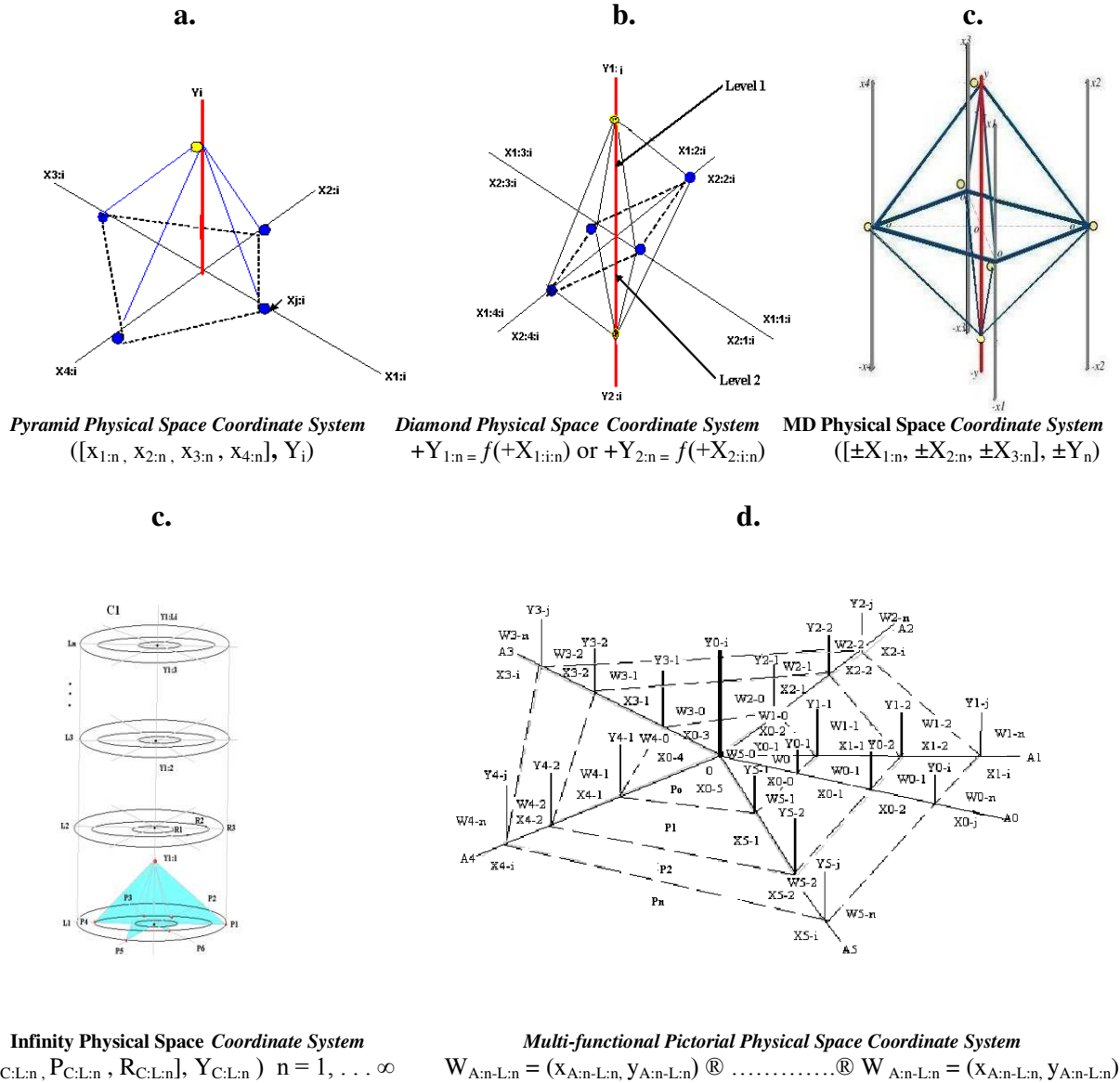
However, the multi-dimensional graphs have different quadrants are distributed "n" number of variables that they are moving constantly and generating different graphical representations. At the same time, each quadrant into the multi-dimensional graphs shows the behavior of all variables that moving at different speeds of time. Hence, we assume that exist different types of time; these times are following by the general time, partial times and constant times. Initially, the general time is running in all multi-dimensional graph quadrants. For the partial time, it is the present time that it is running now in each quadrant into the multi-dimensional graphs but always the partial time became constant time.

Moreover, it is important to be mentioned about the role of the Euclidian geometry (Dodge, 2004) and Minkowski's 4-Dimensional space (Einstein, 1951) to support our proposition. These two geometrical modeling frameworks are supported by its formal mathematical theoretical frameworks. In fact, these two geometrical modeling frameworks don't show any graphical modeling to facilitate the visualization of 4-Dimensional until Infinity Dimensional graphs. In our case Econographicology proposes a set of new multi-dimensional graphs that is missing in the Euclidian geometry and Minkowski's 4-Dimensional graphical modeling.

The rationale of Econographicology revolves around the efficacy of multi-dimensional (MD) graphs as the most effective analytical tool for visualization of any economic phenomena. The main motivation behind the creation of Econographicology is to evaluate graphs evolved so far in economics and to develop new type of graphs to facilitate the study of economics, as well as finance and business. Thereby, the mission of Econographicology is to offer academics, researchers and policy maker's alternative analytical tool in the research and teaching-learning process of economics, finance, sciences and business. At the inception of Econographicology, the following new types of graphs are presented: Pyramid Physical Space (See Figure 2, Picture a.), Diamond Physical Space (See Figure 2, Picture b.), Multi-Dimensional Physical Space (See Figure 2, Picture c.), Infinity Physical Space (See Figure 2, Picture d.) and Multi-functional Pictorial Physical Space (See Figure 2, Picture d.). These Multi-dimensional graphs are constructed based on the traditional 3-D space concept, but they represent 4-D, 5-D, 8-D, 9-D and Infinity-Dimension. The multiple-dimensional representations are to facilitate easy understanding of economic phenomena from a general view.

Finally, we can observe in the large number of multi-dimensional graphs offer by Econographicology (Ruiz, 2007), it is possible to plot and visualize large number of economic variables, equation and functions simultaneously in the same graphical space that is not possible to be visualized on the 2-Dimensional and 3-Dimensional graphs. Hence, the idea of economic analysis through time and space change completely in form and content.

Figure 2:
Pyramid Physical Space, Diamond Physical Space, Multi-Dimensional Physical Space, Infinity
Physical Space and Multi-functional Pictorial Physical Space.

a.

Pyramid Physical Space Coordinate System
$([x_{1:n}, x_{2:n}, x_{3:n}, x_{4:n}], Y_i)$

b.

Diamond Physical Space Coordinate System
$+Y_{1:n} = f(+X_{1:i:n})$ or $+Y_{2:n} = f(+X_{2:i:n})$

c.

MD Physical Space *Coordinate System*
$([\pm X_{1:n}, \pm X_{2:n}, \pm X_{3:n}], \pm Y_n)$

c.

Infinity Physical Space *Coordinate System*
$([X_{C:L:n}, P_{C:L:n}, R_{C:L:n}], Y_{C:L:n})$ n = 1, . . . ∞

d.

Multi-functional Pictorial Physical Space Coordinate System
$W_{A:n-L:n} = (x_{A:n-L:n}, y_{A:n-L:n})$ ® …………® $W_{A:n-L:n} = (x_{A:n-L:n}, y_{A:n-L:n})$

Conclusion

From now economists, academics and policy makers are available to have an alternative multi-dimensional graphical modeling to visualize a large number of variables, equations and functions join together into the same graphical space and study economics such as a whole, without any graphical limitation.

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