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Ruiz Estrada, M.A.

University of Malaya

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Mario Arturo RUIZ Estrada
University of Malaya

***Abstract*:** This paper shows a new optical visualisation of demand and supply based on the application of surfaces. The objective of initiating the demand and supply surfaces is to propose the application of multi-dimensional graphs among academics, economists and policy makers in the study of microeconomics and macroeconomics analyses in the short and long term. To create the demand and supply surfaces, this research suggests applying "the Infinity Cartesian space (I-Cartesian space)" (Ruiz 2006). In applying I-Cartesian space, the researcher is able to use the large number of Cartesian spaces offered in Econographicology[1].

Keywords: Cartesian spaces, econographicology, economic teaching, microeconomics, multi-dimensional graphs
JEL classification: E60

1. Introduction

For centuries, many economists have had the opportunity to use different graphical methods to explain various economics phenomena based on the application of 2-dimensional or so far 3-dimensional Cartesian planes. These are cases whereby the analytical graph system is used in economics, where the form of the graph gives an idea of the possible class of functions describing the relationship between *X* and *Y* variables. As far as the application of the analytical graphical method in economics is concerned, it is necessary to mention the major contribution of Cournot. Cournot (1838) derived the first formula for the rule of demand and supply as a function of price. He was also the first economist to draw the demand and supply curves on a graph (2-dimensional view). Cournot believed that economists should utilise graphs only to establish probable limits and express less stable facts in more absolute terms. He further held that the practical use of mathematics in economics involves not only strict numerical precision, but also graphical visualisation. Besides Cournot and Jevons, other innovative economists who contributed to the analytical graph system in economics over time were Leon Walras, Vilfredo Pareto, Alfred Marshall and Francis Ysidro Edgeworth (McClelland 1975).

This paper focuses on introducing a new graphical method called Econographicology (Ruiz 2007). The rationale of Econographicology revolves around the efficacy of multi-dimensional (MD) graphs in the storage of meta-database and the visualisation of multi-variable data behaviour based on the application of Cartesian spaces (or MD Cartesian

* Faculty of Economics and Administration, Department of Economics, University of Malaya, 50603 Kuala Lumpur
Email: *marioruiz@um.edu.my*

[1] Econographicology is defined as a multi-dimensional graphical method to facilitate meta-database storage and multi-variable data behaviour visualisation. It stems from the necessity to generate an alternative and specialised multi-dimensional graphical method for economics, business and finance (Ruiz 2007).

coordinate system). The main idea is to demonstrate the use of the MD Cartesian coordinate system that Econographicology offers. The Cartesian space used is called the 'infinity Cartesian space (I-Cartesian space).' The I-Cartesian space is employed in the construction of the demand and supply surfaces.

2. The Infinity Cartesian Space (I-Cartesian Space)

The I-Cartesian space is formed by two quadrants and each quadrant has the form of a cylinder. The construction of the first quadrant on the top of the I-Cartesian space is based on joining together each 'Y_i' *(Y_0, Y_1, Y_2, Y_3...Y_∞)* until all 'Y_i' together can build a single cylinder. Each 'Y_i' axis has values between 0 and ∞, therefore all 'Y_i' represent the dependent variables. The construction of the second quadrant on the bottom of the I-Cartesian space arises from joining together each 'X_i' *(X_0, X_1, X_2, X_3...X_∞)* until all 'X_i' together build a single cylinder. Each 'X_i' axis has values between 0 and ∞, therefore all 'X_i' represent the independent variables (see Figure 1). The I-Cartesian space assumes that some or all changes in the first quadrant values (independent variables) can affect directly the behaviour of the second quadrant values (dependent variables). Finally, the I-Cartesian space is based on joining the first quadrant on the top with the second quadrant on the bottom to build a long single cylinder.

3. The Demand and Supply Surfaces

Demand and supply curves in the 2-dimensional format continued to be used by economists until today. In such a case, the demand curve shows the inverse relationship between prices and quantity demanded for any good or service represented on a simple graph. This graph shows the relationship between price and quantity according to the law of demand, as seen in the downward slope effect. In the case of the supply curve, it shows the amount of a good or service that producers make available for sale for each possible price during a specific period of time. The supply curve shows that the relationship between prices and

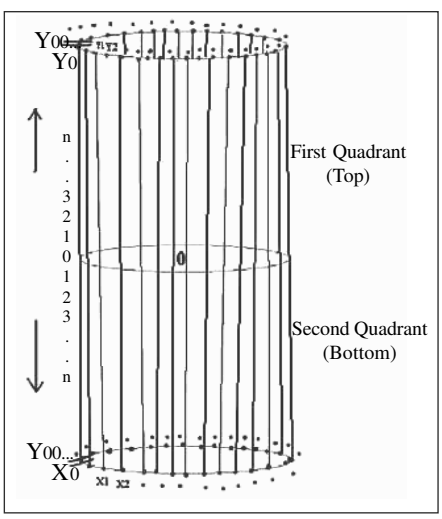

Figure 1: *The infinity Cartesian space (I-Cartesian space)*

quantity supplied is proportional according to the law of supply, seen in the upward slope effect (McConnell and Brue 2002).

To build the demand and supply surfaces, five basic steps are required:

a. The General Real Price Curve (GP-Curve)
The initial stage in the construction of the general real price curve starts by the creation of the first quadrant in the I-Cartesian space. This construction of the first quadrant is based on joining each price line or each 'Y_i' axis *(Y_0, Y_1, Y_2, Y_3...Y_∞)* until all price lines or all "Y_i" axes combine to generate a single cylinder (or the first quadrant) on the top of the I-Cartesian space; each real price line has a value between 0 and ∞. Therefore, we plot each real price value on the respective line. Finally, if we join the tip of each real price line on the first quadrant of the I-Cartesian space from the bottom left side of the quadrant (Po) to the top right side (P_∞), this yields the general real price curve. The general real price curve has an upward slope trend (Figure 2). We conclude that the GP-curve following a geometrical progression and not an arithmetic progression as in accordance to the traditional demand and supply curves plotted in two dimensions.

b. Quantity-Demanded and Quantity-Supplied Curves
The second quadrant of the I-Cartesian space shows the quantity-demanded and quantity-supplied curves. The quantity-demanded curve is plotted from the top right side (QD_∞) to the bottom left side (QD_o) in the second quadrant of the I-Cartesian space. The quantity-demanded curve shows a downward slope trend. Second scenario, the quantity-supplied curve is plotted from the bottom right side (QS_∞) to the top left side (QS_o) in the second quadrant of the I-Cartesian space. The quantity-supplied curve shows an upward slope trend (Figure 3).

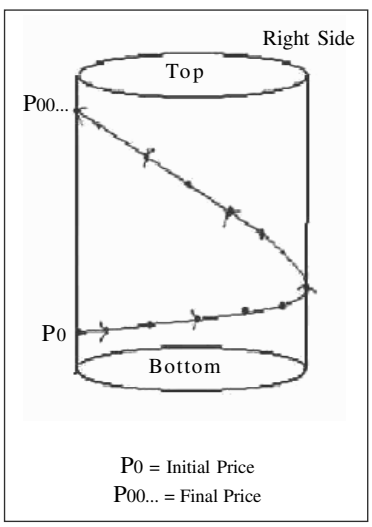

Figure 2: *The general real price curve*

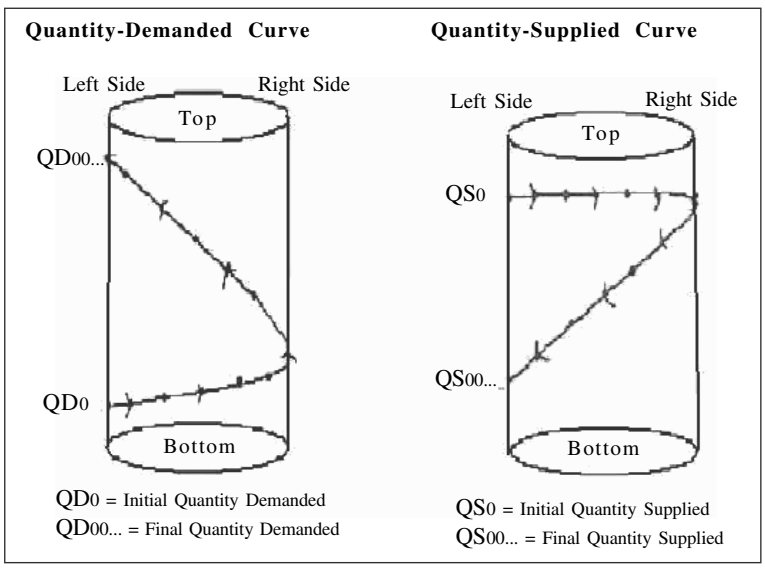

Figure 3: *Quantity-demanded and quantity-supplied curves*

c. Demand Surface

Our classic representation of the demand curve is one where the quantity-demanded is determined on the horizontal axis and price is determined on the vertical axis. In the case of the demand surface discussed in this paper, the demand surface is fixed between the two quadrants in the I-Cartesian space.

However, to build the demand surface, we need to follow a series of steps: The first step is the construction of the general real price curve on the top of the I-Cartesian space. The second step is to build the quantity-demanded curve on the bottom of the I-Cartesian space. Finally, the construction of the demand surface is based on joining each real price value from the general price curve with each value of the quantity-demanded curve respectively. We can observe that the demand surface looks like a large band with spiral linear behaviour (see Figure 4). The demand surface continues to follow the law of demand. All else equal, as price falls, the quantity demanded rises, and as price rises, the quantity demanded falls. The demand surface shows a downward slope trend into the I-Cartesian space.

d. Supply Surface

The construction of the supply surface follows similar steps to those of the demand surface. The supply surface continues to follow the law of supply. As price rises, the quantity-supplied rises; as price falls, the quantity supplied falls. The supply surface continues to have an upward slope trend, but with different graphical representation from that of the 2-dimensional approach. The construction of the supply surface involves a series of steps: The first step is the creation of the general price curve. The second step is supported by the construction of the quantity-supplied curve. Finally, the supply surface is based on joining

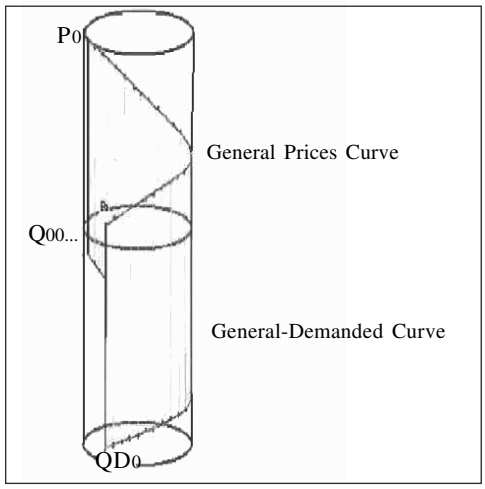

Figure 4: *Demand surface*

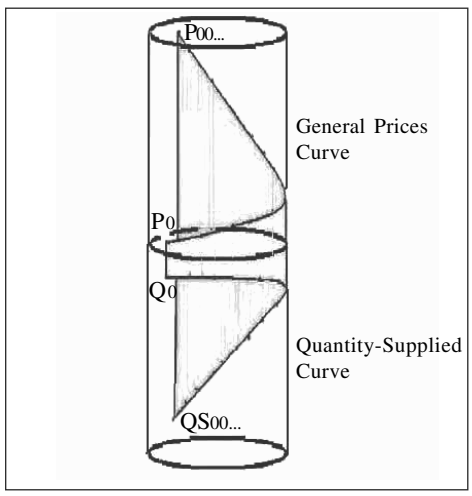

Figure 5: *Supply surface*

each real price value from the general real price curve with each value of the quantity-supplied curve respectively. We can observe that the supply surface looks like a large band with spiral behaviour with an upward slope trend (Figure 5).

e. Multi-dimensional Market Equilibrium

Finally, when we join the first cylinder (general price curve) on the top and second cylinder (quantity-demanded and quantity-supplied curves) in the bottom, we have a single cylinder divided in two sub-cylinders. The first cylinder shows the behaviour of both variables in the second cylinder shared by the quantity-demand and quantity-supplied curves. The multi-dimensional market equilibrium is captured when the demand and supply surfaces

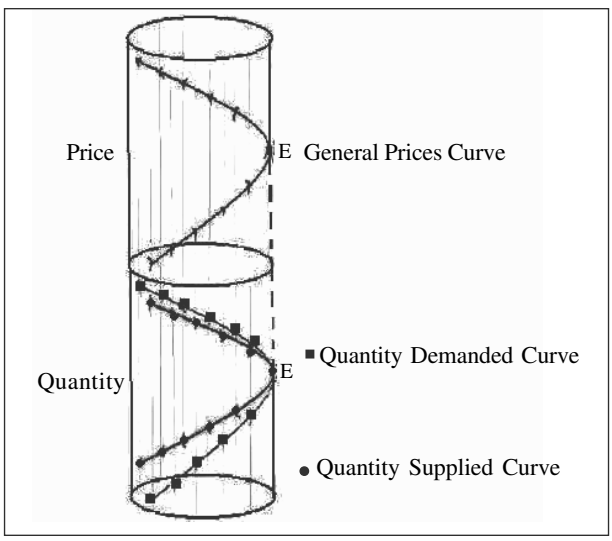

Figure 6: *Multi-dimensional market equilibrium*

intercept at some point between the first and second cylinders in the I-Cartesian space. Finally, the interception between demand and supply surfaces denotes a specific price and quantity value within the I-Cartesian space (Figure 6).

4. Conclusion

According to our research, MD-graphs offer a new method to visualise economic phenomena from an alternative perspective of analysis using a multi-dimensional view. We show that the I-Cartesian space offers an alternative multi-dimensional Cartesian coordinate system to facilitate the study of any economic phenomenon, whether at the macro-level or micro-level, and whether the analysis is short term or long term.

To sum up, multi-dimensional graphs play an important role in research as well as in the teaching-learning process of economics through new methods and techniques of constructing graphs as detailed throughout this paper. We can observe the following:

(i) Price behaviour in the long run follows a geometrical progression (spiral line) and not an arithmetic progression (single line) trend as suggested by the traditional 2-dimensional view.

(ii) Two long bands with a spiral trend represent the demand and supply curves from the MD view, but in the case of the 2-dimensional view, it is represented by two single lines.

(iii) Prices affect the quantity demanded and supplied, and the quantity demanded and supplied also affect price behaviour, thereby suggesting two-way causality.

(iv) Supply and demand surfaces can be used to demonstrate how different markets behave simultaneously.

References

Cournot, A. Augustin.1838. Research on the mathematical principles of the theory of wealth. *Journal of Political Economy* **6(3)**: 426-430

McConnell, C. and S. Brue. 2002. *Economics: Principles, Problems and Policies.* 15th edn. McGraw-Hill Irvin.

McClelland, P. 1975. *Causal Explanation and Model Building in History, Economics, and the New Economic History*. Cornell: Cornell University Press.

Ruiz Estrada, Mario A. 2006. Application of infinity Cartesian space (I-Cartesian space): oil prices from 1960 to 2010. Faculty of Economics and Administration – University of Malaya. FEA-Working Paper: No.2006-10.

Ruiz Estrada, Mario A. 2007. Econographicology. *International Journal of Economic Research* **4(1)**: 93-104.