NEW VISUAL PERSPECTIVE FOR ECONOMIC ANALYSIS: THE MULTI-DIMENSIONAL CARTESIAN PLANE (MD Cartesian Plane)

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I. - Abstract

The objective of this paper is to introduce an alternative type of Cartesian plane – Multi-Dimensional Cartesian plane (MD Cartesian plane) – for both microeconomics and macroeconomics levels of analyses. Different from the traditional 2-Dimensional Cartesian plane (x,y) and 3-Dimensional Cartesian plane (x,y,z), MD Cartesian plane consists of five axes ([x1,x2,x3,x4],y), where each axis has positive and negative values.

In this paper MD Cartesian plane will be applied to macroeconomics level analysis, specifically to observe the global dimension of the Gross Domestic Product (GDP). Prior to the detailed explication and application of MD Cartesian plane, this paper explores the different type graphs that have been applied in economics so far, for comparison purposes.

MD Cartesian plane is highly flexible. It can be adapted not only to microeconomics and macroeconomics analyses, but also to research in other areas such as finance, accounting, management, business and public administration. MD Cartesian plane is essentially an alternative analytical tool for policy makers, researchers and academicians in all fields.

II.- Introduction

In economic analysis, so far two systems of planes have been used: basic analytical plane system based on 2-D Cartesian plane and complex analytical plane system under 3-D Cartesian plane. The basic

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The same paper was presented in the department of Economics at National University of Singapore (NUS), November 2004.

analytical plane system was first used in the XIX century. It started with Antoine Augustin Cournot's work, where mathematics began to be used in Economics. Basic analytical graph system consists of Utility Theory, General Equilibrium, Optimal of Pareto, Partial Equilibrium and Indifference Curves. These graphs were introduced by innovator economists William Stanley Jevons, Leon Walras, Vilfredo Pareto, Alfred Marshall and Francis Ysidro Edgeowrth respectively. (McClelland, 1975)

The complex analytical plane system has its origin in the XX century. It started with the introduction of sophisticated mathematics techniques in the development of new economic models. Calculus, trigonometry, geometry, statistical methods and forecasting methods are used in these graphs. 3-Dimensional Cartesian plane (3-D) is also part of the complex analytical plane system and is applied in economic research. (Ovondo-Bodino, 1967)

Using the complex analytical plane system based on 2-D and 3-D Cartesian planes were the following economic models: General equilibrium and Welfare Theory (John R. Hicks), IS-LM Curve (Alvin H. Hansen), Development of Economic Theory: Static and Dynamic Analysis, (Paul A. Samuelson), Econometrics (Lawrence R. Klein), Phillips Curve (Alban W. Phillips), Okun Law (Arthur M. Okun), Economic Growth Theory (Robert M. Solow), Game Theory (John F. Nash and John von Neumann), Introduction of Dynamic Models and Econometrics (Jan Tinbergen), Monetary Theory (Milton Friedman), Rational Expectations Theory (Robert J. Barro).

The rapid development of complex analytical plane system was facilitated by high technology and sophisticated instruments of analysis such as the electronic calculator and the computer. The development of the instruments of analysis in economics took place in two stages. The first stage involved the "Basic Computational Instruments", where electronic calculators were used to compute basic mathematical expressions (e.g. long arithmetic operations, logarithm, exponents and squares). This took place between the 1950's and 1960's.

The second stage of development took place in the middle of the 1980's. This is when high speed and high storage computers with sophisticated software were first used. Called "High Computational Instruments", such sophisticated software enables easy information

management, application of difficult simulations as well as the creation of high resolution under 3-D Cartesian plane. These instruments contributed substantially to the development and research of economics.

Each of the Basic Analytical Plane System and Complex Analytical Plane System can be categorized according to functions or dimensions. In terms of functions, the planes are either descriptive or analytical. In terns of dimensions, the graph can be either 2-D or 3-D Cartesian planes.

In descriptive graphs, arbitrary information is used to observe the effect of theories. Analytical graph, on the other hand are time-series graphs, cross-section graphs and scatter diagrams. In analytical graphs, statistical data is used to show trends and relationships between two or more variables, and hence the effects of economic phenomena resulting from trade policy, monetary policy, fiscal policy, economic growth and economic development. The analytical focus of the graphs is supported by the application of high computational instruments based on sophisticated hardware and software.

Based on 100 papers published in recognized 21 economic journals[1] between 1940's and 2004 (JSTOR, 2004), it is observed that the common types of graphs applied in the study of social sciences, especially in economics are 2-D and 3-D Cartesian planes. MD Cartesian plane introduced in this paper, however, is a multi-dimension Cartesian plane. It enables economists to analyze economic phenomena from multiple perspectives and facets in space and time.

III. Framework of Multi-Dimension Cartesian Plane (MD Cartesian plane)

In MD Cartesian plane, the Cartesian plane consists of five axes ([x1, x2, x3, x4], y), representing four independent variables "x1", "x2", "x3" and "x4" and one dependent variable "y" respectively. Each "x" variable (x1, x2,

[1] **American Economic Review, *C*anadian Journal of Economics, Econometrica, Economic History Review, Economic Journal, International Economic Review, Journal of Economic History, Journal of Economic Literature, Journal of Political Economy, Oxford Economic Papers, Quarterly Journal of Economics, Review of Economic Studies, Review of Economics and Statistics, Canadian Journal of Economics and Political Science, Journal of Economic Abstracts, Contributions to Canadian Economics, Journal of Labor Economics, *J*ournal of Applied Econometrics, Journal of Economic Perspectives, Publications of the American Economic Association, Brookings Papers on Economic Activity. Microeconomics *and* American Economic Association Quarterly.**

x3, x4) and “y” variable has its individual axis that is a vertical line with both positive and negative values. The positive and negative values are represented by ([(x1,-x1), (x2,-x2), (x3,-x3) (x4,-x4)], (y,-y)] on the MD Cartesian plane.

In the case of 2-D and 3-D Cartesian plane, the individual variables can be anywhere along the vertical and horizontal axes; but in the case of MD Cartesian plane all variables (xi) and the “Y” variable are either on the positive side of respective axes together on the negative side of their respective axes together. In other words, the values of all “xi” (x1, x2, x3, x4) and “y” increase or decrease in the same direction. Therefore, any change in some or all “xi” will affect “y” directly. (See Figure 1).

Representing the dependent variable, the fifth axis, “y” is positioned in the center of the graph (among the other four axes). “y” has a positive value and negative value. It is the convergent point of all the other four axes x1, x2, x3 and x4. In other words, all “xi” axes converge at the “y” axis. The result is a figure represented by a pyramid that can be reshaped into two cubes or one cube.

IV. Comparison of 2-D Cartesian plane, 3-D Cartesian plane and MD Cartesian plane

2-D and 3-D Cartesian plane have the limitation of not being able to show the relationship of several variables at the same time. 2-D Cartesian plane shows the relationship between one independent variable “x” and one dependent variable “y”. 3-D Cartesian plane (x, y, z) shows the relationship between two independent variables (x, y) and one dependent variable is “z”. MD-Cartesian Plane with its five axes ([(x1, x2, x3, x4), y)] however, shows the relationship between four independent variables ([(x1,-x1), (x2,-x2), (x3,-x3) (x4,-x4)] simultaneously and one dependent variable (y,-y).

In the case of 2-D and 3-D Cartesian planes, only the positive axes can be used by economists to analyze changes in some economic phenomenal (resulting from inflation, economic growth, Unemployment.) In the case of MD Cartesian plane, both positive and negative axes can be used to observe any economic changes (See Table 1 and Figure 1.)

V. Application of the Multi-Dimension Cartesian plane (MD Cartesian plane)

In this paper, the application of MD Cartesian plane is demonstrated by its use in finding the national income "y" accounts divide GDP into four broad categories of spending. In particular, the GDP is the sum of Consumption, Investments, Government Purchases and Net Exports, represented by "C", "I", "G" and "(X-M)" respectively in the expressions below (Mankiw, 2000). In the graphs in Figure 1 and Figure 2, these four broad categories of spending of GDP are independent variables represented by x1, x2, x3 and x4 respectively, while the national income is represented by "y".

MD Cartesian plane is applied in any year of any Country. For demonstration purposes, the following data is used: Consumption (C) = 3; Investment (I) = 2; Government Purchases (G) = 2; Exports (X) = 5 and Imports (M) = 7.

Steps involved in the application of MD Cartesian plane are as follows.

First step - to define national income: Expression (1)

$$(1.) \quad Y = GDP = C+I+G+(X-M).$$

Second step – to input all data into Expression (1)

$$Y = GDP = [C = (x1)] + [I = (x2)] + [G = (x3)] + [(X-M) = (x4)]$$

$$Y = GDP = 3 + 2 + 2 + (5-7)$$

$$Y = GDP = x1\ (3) + x2\ (2) + x3\ (2) - x4\ (2)$$

$$Y = 5$$

Third step - to plot the resultant GDP in its four broad categories of spending of C, I, G and NT (X-M)

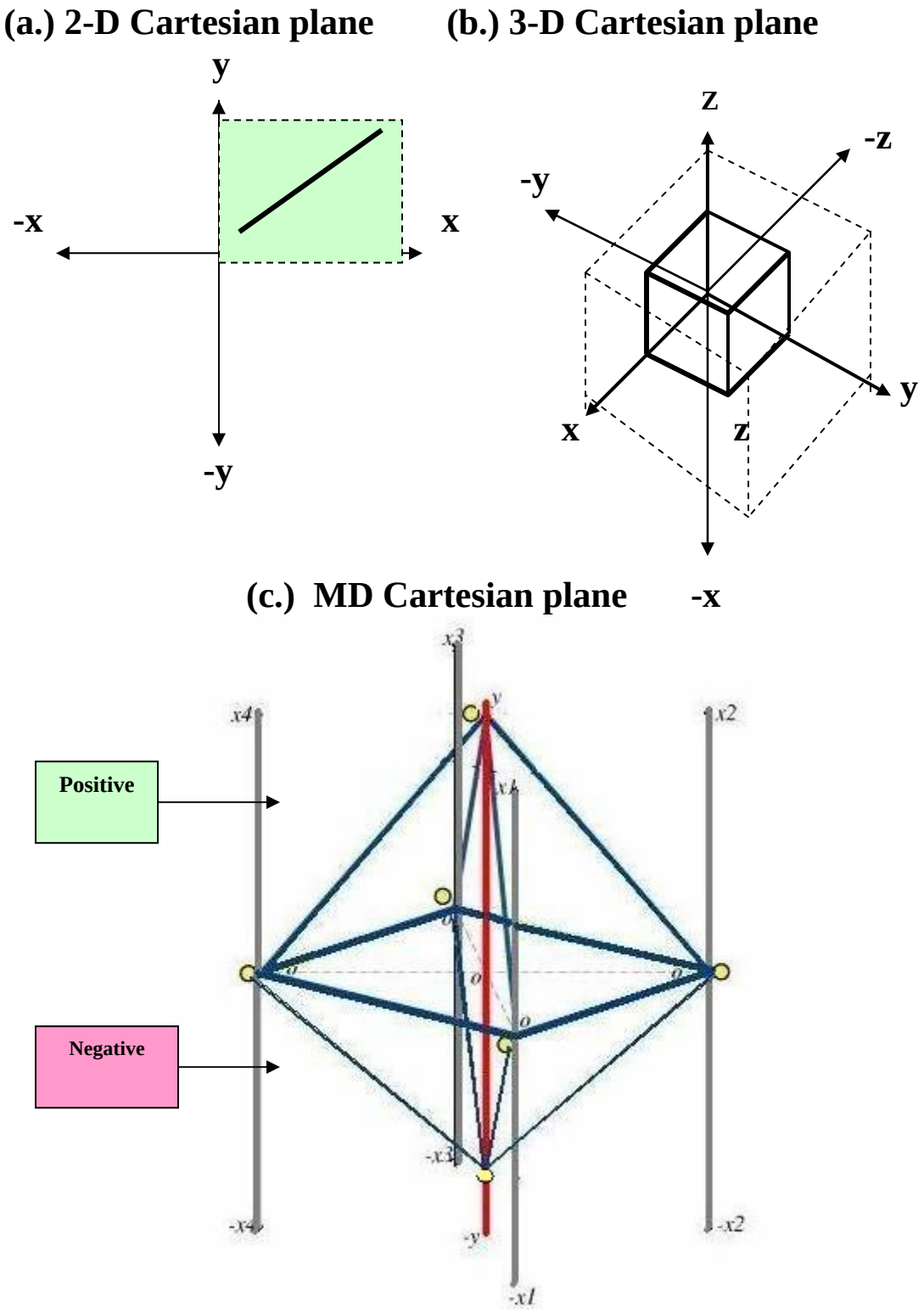
MD Cartesian plane shows the national income from new visual perspective. Concurrently it shows the relationships between all the GDP spending variables (C, I, G, NT) and the national income (Y). This feature in MD Cartesian plane represents multiple perspectives or more precisely, the global dimension of the national income (Y). In other words, MD Cartesian plane shows the global dimension of the national income by observing the movement of one or all variables (x1, x2, x3, x4) along their respective axes simultaneously on the same plane as a whole. It also shows how any changes in one or all "xi" affect "y" in space and time (See Figure 2).

Table 1
Difference between 2-D, 3-D and MD Cartesian plane

DIMENSION	AXIS	VARIABLES	VALUES
2-DIMENSIONAL Cartesian plane 2-D	2 Axes (x,y)	1 Dependent **(Y)** 1 Independent **(X)**	**(x,y) & (-x,-y)**
3-DIMENSIONAL Cartesian plane 3-D	3 Axes (x,y,z)	1 Dependent **(Z)** 2 Independent **(X,Y)**	**(x,y,z) & (-x,-y,-z)**
MULTI-DIMENSIONAL Cartesian plane MD	5 Axes ([x1,x2,x3,x4],y)	1 Dependent **(Y)** 4 Independent **(X1,X2,X3,X4)**	**([x1,x2,x3,x4] , y) & ([-x1,-x2,-x3,-x4], -y)**

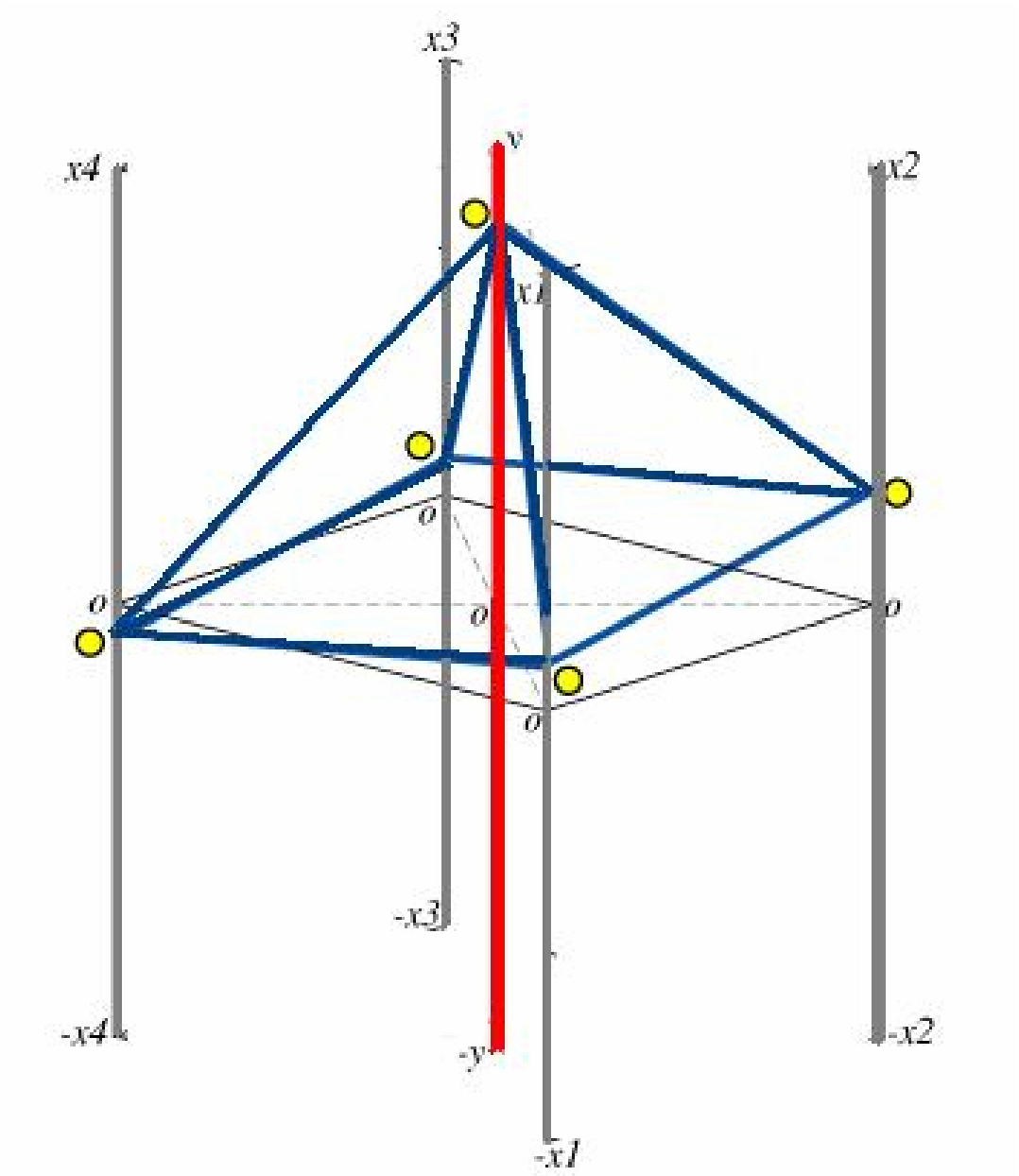
Source: By Mario A. Ruiz Estrada

F I G U R E 1
The 2-D, 3-D and Multi-Dimensional Cartesian plane (MD Cartesian plane)



Source*: *Plane designed and developed by MARIO A. RUIZ ESTRADA

F I G U R E 2
The Multi-Dimensional Cartesian plane (MD Cartesian plane)



Source*: *Plane designed and developed by MARIO A. RUIZ ESTRADA

VI. - CONCLUSION

The MD Cartesian plane shows the global context of any economic phenomena. Hence it allows for Macro-Microeconomics focus of analysis in economics. In summation, it is an efficient analytical tool to explain complex economic phenomena from a global perspective – and is a better analytical tool compare to the conventional 2-D and 3-D Cartesian planes.

VII.- BIBLIOGRAPHY

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