Mario Arturo Ruiz Estrada[1]

APPLICATION OF THE SPECIAL THEORY OF RELATIVITY, GENERAL THEORY OF RELATIVITY AND BLACK HOLES TO ECONOMICS

This research shows that the application of the special theory of relativity, general theory of relativity and black holes to economics is possible. The paper is divided into 3 sections. The first section proposes the application of the special theory of relativity by Albert Einstein in economics. This is based on the measurement of the energy of the economics (E). The construction of the energy of the economics (E) is based on 2 economic variables such as the unemployment growth rate and the technological development speed. The second section will present the general theory of relativity develop by Albert Einstein (1916) for the analysis of international trade. Hence, this theory of physics can help to explain the behavior of international trade among nations and how a large country with a constant expansion of its international trade mass (D) can generate a strong international trade gravity attraction with traditional trade partners and possible new trade partners. The third section of this paper proposes a theoretical framework of macroeconomic black holes. The idea is to observe how macroeconomic black holes can generate economic growth.

Keywords: *econographicology, econophysics, economic teaching, multidimensional graphs and multidimensional physical spaces, macroeconomic policy.*

JEL: *E60, B40.*

Маріо Артуро Руїс Естрада

ЕКОНОМІЧНЕ ЗАСТОСУВАННЯ СПЕЦІАЛЬНОЇ ТЕОРІЇ ВІДНОСНОСТІ, ЗАГАЛЬНІЙ ТЕОРІЇ ВІДНОСНОСТІ І ПОНЯТТЯ "ЧОРНІ ДІРИ"

У статті (перший розділ) запропоновано застосування спеціальної теорії відносності А. Ейнштейна в економіці, засноване на вимірі енергії економіки. Енергія економіки базується на двох економічних показниках — зростанні безробіття і швидкості технологічного розвитку. Другий розділ присвячено застосуванню загальної теорії відносності А. Ейнштейна (1916) до аналізу міжнародної торгівлі. Ця теорія може пояснити характеристики міжнародної торгівлі і те, як велика країна з постійним розширенням своєї міжнародної торгівлі може генерувати сильну міжнародну "гравітацію торгівлі" з традиційними торговельними партнерами і потенційними партнерами. У третьому розділі запропоновано теоретичну основу макроекономічної "чорної діри", показано, як макроекономічні "чорні діри" уповільнюють економічне зростання.

Ключові слова: *еконографікологія, еконофізіка, економічне вчення, багатовимірні графіки і багатовимірні фізичні простори, макроекономічна політика.*

Рис. 9. Фор. 8. Літ. 11.

Марио Артуро Руис Эстрада

ЭКОНОМИЧЕСКОЕ ПРИМЕНЕНИЕ СПЕЦИАЛЬНОЙ ТЕОРИИ ОТНОСИТЕЛЬНОСТИ, ОБЩЕЙ ТЕОРИИ ОТНОСИТЕЛЬНОСТИ И ПОНЯТИЯ "ЧЕРНЫЕ ДЫРЫ"

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В статье (первый раздел) предложено применение специальной теории относительности А. Эйнштейна в экономике, основанное на измерении энергии экономики. Энергия экономики основана на двух экономических показателях — росте безработицы и скорости технологического развития. Второй раздел посвящен применению общей теории относительности А. Эйнштейна (1916) к анализу международной торговли. Эта теория может объяснить характеристики международной торговли и то, как большая страна с постоянным расширением своей международной торговли может генерировать сильную международную "гравитацию торговли" с традиционными торговыми партнерами и потенциальными партнерами. В третьем разделе предложена теоретическая основа макроэкономической "черной дыры", показано, как макроэкономические "черные дыры" замедляют экономический рост.

Ключевые слова: *эконографикология, эконофизика, экономическая школа, многомерные графики и многомерные физические пространства, макроэкономическая политика.*

Section I: Measuring the Energy of Economics (E)

1.1. Introduction. Before we go deeply into the measurement of the energy of economics (E) we need to do a general review on the special theory of relativity and how this theory works. Initially, we can mention that the great contribution of Albert Einstein is the establishment and development of the special theory of relativity. It is based on joining 2 fundamental laws in physics into a single law. This single law is called the special theory of relativity, where the law of conservation of energy (C^2) and the law of conservation of mass (M) were joined together into a single equation identified by $E=MC^2$.

According to Einstein's special theory of relativity, "if followed from special theory of relativity that mass (M) and energy (E) are both but different manifestations of the same thing. A somewhat unfamiliar conception for the average mind. Furthermore, Energy (E) is equal to MC^2, in which energy is put equal to mass (M), multiplied by the square of the velocity of light shows that very small amounts of mass may be converted into a very large amount of energy and vice versa. Mass (M) and energy (E) were in fact equivalent according to the formula mentioned before, as demonstrated by Cockcroft and Walton in 1932, experimentally (Einstein, 1952). This paper tries to use the special theory of relativity to measure the energy of economics and demonstrate that it is possible to apply the formula $E=MC^2$ to economic analysis. We are using 2 variables, the unemployment growth rate (U) and the technological development speed (T^2) to measure the final energy of economics (E). We'd like to say that the measurement of energy of economics (E) can be an alternative approach to analyze economic behavior from a different point of view.

1.2. Introduction to the Energy of Economics (E). Initially, we suggest the application of the equation $E=MC^2$ to measure the energy of economics (E). Hence, we suggest to replaces the original variables in $E=MC^2$ by 2 economic variables to measure the energy of economics (E). The energy (E) we like to replace by the energy of economics by (E); the mass (M) is replaced by the unemployment growth rate U (see Expression 1) and C^2 will be replaced by the technological development speed represented by T^2 (Expression 2). We suggest to calculate first the final unemployment growth rate between 2 years, in our case we apply partial differentiation based on time, we have 2 periods of time divided by the past year (t) and the next year (t+1):

$$\delta U_{t+1}/\delta U_t \equiv U. \quad (1)$$

On the other hand, in the construction of the technological development speed (T^2) , we need to start by building the final technological output "δV" that is based on the total sum of 3 large integrals under the uses of the total sum of patents registered ($\int\Sigma\alpha_i$) plus the total sum of the technologies sells ($\Sigma\int\beta_j$) plus the total sum of all projects related to R&D ($\Sigma\int\theta_k$) (Expression 3). Hence, the variable "t" represents time, in our model we calculate time based on the growth rate between 2 years. To measure the technological development speed (T^2), we suggest to apply the original formula of speed that is equal to distance divided by time (D/t); but in our case we replace distance by the final technological output "δV". We assume that the technological development speed (T^2) is not a constant variable in our equation such as the speed of the light is explained into the formula $E = MC^2$. We suggest to measure the energy of economics (E) keeping the technological development speed (T^2) variable because the constant challenges of research, development and innovation (RDI) always generate a constant transformation in the production of new goods and services at the market. Secondly, why the T^2 need to be a variable is because natural phenomenon can be measured with accuracy based on experimentation such as the speed of light (C^2), but in the case of social phenomenon such as economics cannot be measure with accuracy based on the experimentation at the same level that the natural phenomenon, it is the case of technological development. However, another reason about why the technological development speed (T^2) is exponential square, it is because we assume that the technological development speed can generate a double spillover effect on the final amount of energy of economics (E) in the short and long term. In this part of our model, we request the application of partial differentiation into the measure of the δV and δT (Expressions 4 and 5).

$$T^2 \equiv (\delta V/\delta t)^2 \quad (2)$$

$$V = \int^{\infty}\alpha_i + \int^{\infty}\beta_j + \int^{\infty}\theta_k \quad (3)$$

$$\delta V = \delta V_{t+1}/\ \delta V_t \quad (4)$$

$$\delta T = \delta T_{t+1}/\ \delta V_t \quad (5)$$

Finally, the formula of the energy of economics (E) is equal to:

$$E=UT^2 \quad (6)$$

The formula of the energy of economics (E) can show 4 possible results. First result, if we have low rate of unemployment (U) multiplied by high technological development speed square (T^2) then UT^2 together can convert into a very large amount of energy of economics (E). Second result, if we have a high rate of unemployment (U) multiplied by low technological development speed (T^2), then UT^2 together can convert into a very small amount of energy of economics (E). Thirdly, if we have a high rate of unemployment (U) multiplied by high technological development speed square (T^2), then UT^2 together can convert into a very small amount of energy of economics (E). The fourth result, if we have low rate of unemployment (U) multiplied by low technological development speed square (T^2), then UT^2 together can convert into a very small amount of energy of economics (E).

To measure the energy of economics (E), we request the application of the Omnia Mobilis Assumption (Ruiz Estrada, 2011), translated from Latin it means "everything is moving". The Omnia Mobilis assumption gives the freedom to our equation of energy economics (E) to use less ceteris paribus assumption into our modeling. Simultaneously, we assume also that the market always keeps in a "dynamic imbalanced state" (Ruiz Estrada, 2012) under no control and is highly vulnerable. In fact, the concept of equilibrium in economic modeling of energy of economics (E) is considered as a leak momentum of balance between unemployment growth rate (U) and technological development speed (T^2) that can appear any time, but we cannot predict when exactly this synchronized balance is going to be appeared. From the graphical perspective, we suggest the application of surfaces to visualize the behavior of 4 possible scenarios into the energy of economics equation explained by $E=UT^2$.

Section II: The General Theory of International Trade Relativity.

2.1. Introduction. Initially, our basic argument in this section is that the reduction or expansion of international trade mass (D)[2] by any country can generate outflow or attraction of traditional or new international trade partners. Hence, the expansion of international trade mass (D) by any country can generate a positive effect to increase international trade with traditional trade partners and attraction of new ones. On the other hand, the contraction of international trade mass (D) by any country can generate a possible outflow of its traditional trade partners to another country that has more growth in its international trade mass (D) (Figure 1).

In the analysis for the general theory of international trade relativity is based on the uses of the space-time continuum. It can be considered as a geometrical space under the uses of a formal co-ordinates system (Figure 2). This geometrical space is represented by a manifold or plane surface by combining space and time together. Our first assumption is that the world trade is a large space-time continuum based on the intersection between space and time. Hence, the world trade is represented by the space-time continuum. It is the place that all international trade mass (D) from different countries are displayed in different places (or orbits). In fact, all countries depend on its international trade mass (D) expansion to generate a strong attraction of new trade partners.

[2] In the construction of the international trade mass (D) we use a constant ($\pi = 3.1416$) and the total FOB exports growth rate (ΔX). The calculation of ΔX is based on using the total FOB exports in blns of US$ from the last year (X_{t-1}) and the total FOB exports in billion of US$ from the present year (X_t) (Expression 1).

$$\Delta X = X_t - X_{t-1} / X_t$$

$$D = (4/3)\pi\Delta X2$$

Finally, the analysis of international trade mass (D) is based on the volume of different spheres across different periods of time and spaces. The main variable is the FOB exports growth rates. We find that different sizes of spheres can help us to observe if there exist expansion, contraction or stagnation of the FOB exports growth rates across different periods of time and space. However, we suggest the use of different colors for different spheres. It can help visualizing easily the behavior of international trade mass (D) graphically.

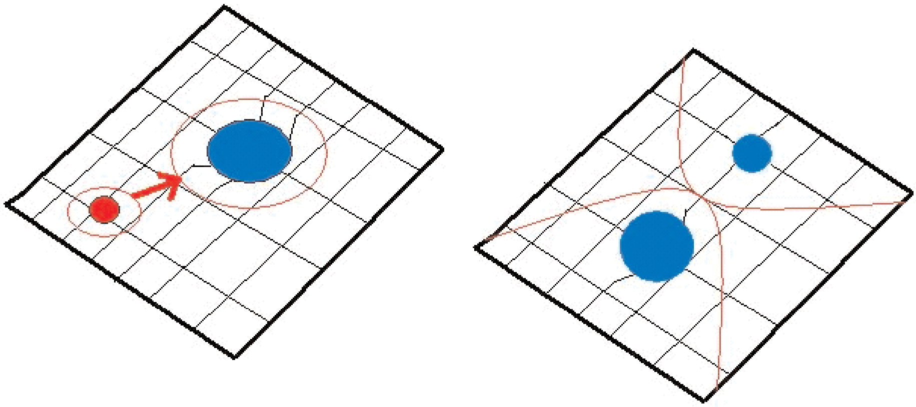

Figure 1. **Transition of Orbits**

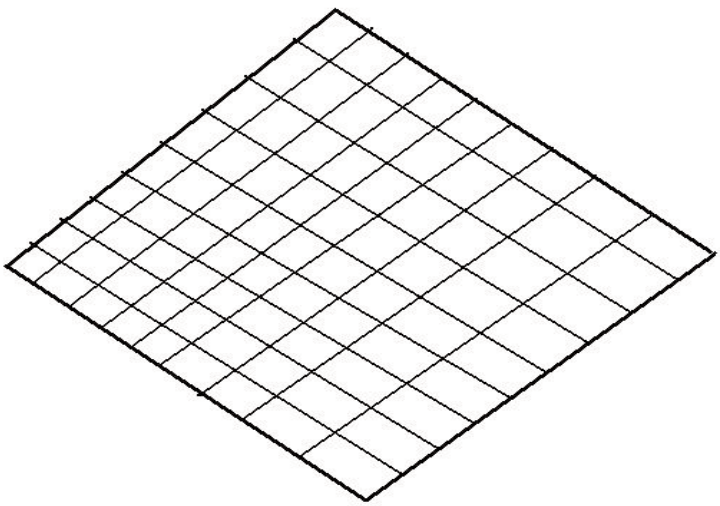

Figure 2. **The Space-Time Continuum**

We assume also that the world trade has 2 types of countries — large international trade mass (D) country and small international trade mass (D') country (Figure 3). Therefore, always small international trade mass (D') of any country is attached to a large international trade mass (D) country (Figure 3). Hence, a small international trade mass (D') country is moving around a large international trade mass (D) country. It is means that a small international trade mass (D') country generates a strong international trade gravity attraction to a large international trade mass (D) country. Therefore, the attraction from a small international trade mass (D') country to larger international trade mass (D) is always strong until exist the possibility of a reduction into the large international trade mass (D) country. It can force a small international trade mass (D') change to another orbit with a country that experiences more high international trade mass (D) expansion. This reduction of mass from any large international trade mass (D) country can be unexpected and fleeted (Figure 1).

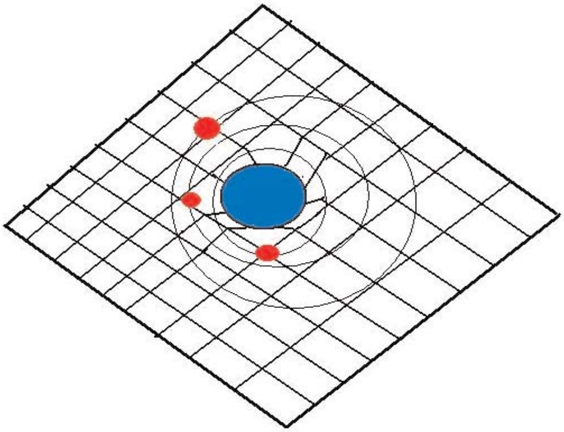

Figure 3. **Large International Trade Mass (Đ) and Small International Trade Mass (Đ')**

Additionally, the general theory of international trade relativity also assumes that international trade mass (D) of a large country always keeps in a constant transformation or evolution across time and space. It means that somday closed trade members can unfold to another country with more international trade mass. The process of transition cannot be determinate WHEN exactly any country can change from its orbit to another country that keep a constant expansion of its international trade mass (Figures 1 and 3).

2.2. Application of the General Theory of International Trade Relativity. The application of the general theory of international trade relativity to the analysis of the world trade to find how a large international trade mass (D) of any country can generate a strong trade gravity attraction from far regions and countries to trading is possible to be probed. It is the case of Japan, China and the European Union with the US (Figure 6). We can observe in 3 different decades that Japan shows a strong trade gravity attraction to the US, especially in 1980's and 90's. However, we can also observe that from the year 2000 until today the trade gravity attraction reduce considerably between Japan and the US Hence, the reduction of international trade mass (D) of the US force to Japan leave its orbit and move to another orbit more far or change to another orbit with a country that experiences a fast and large international trade mass (D), such as China. But in the case of China its fast international trade mass (D) expansion is generating a strong trade gravity attraction to international trade mass (D) of the US in the recent years. In the case of Europe, it was pushed out to another orbit between 1980's and 90's, but also exist a high possibility that the EU is moving to a more far orbit, it is originated after weakening of the international trade mass of the US (Figure 4).

In the case of regional integration, we can observe that the successful trade blocks suggest that minimum one of the members of a same trade block need to have a large international trade mass (D). It can help sustain a strong international trade gravity attraction among the members from the same trade bloc. We'd like to mention the case of Singapore. The economic regional integration of ASEAN members where Singapore is the large trade member of this bloc, we can observe in Figure 7 that the international trade mass (D) of Singapore is not enough to generate a strong trade regional integration gravity attraction among the rest of members of ASEAN such as Thailand, the Philippines and Indonesia. But Singapore shows clearly a strong international trade gravity attraction by the US international trade, it is originated by the large international trade mass (D) of the US is generating on the world international trade. The second case in our study to probe that minimum any trade bloc request a large international trade mass (D) country, is the case of NAFTA integrated by the US, Canada and Mexico, where the US shows a large international trade mass (D) that is enough to attracts its trade bloc members such as Canada and Mexico (Figure 5).

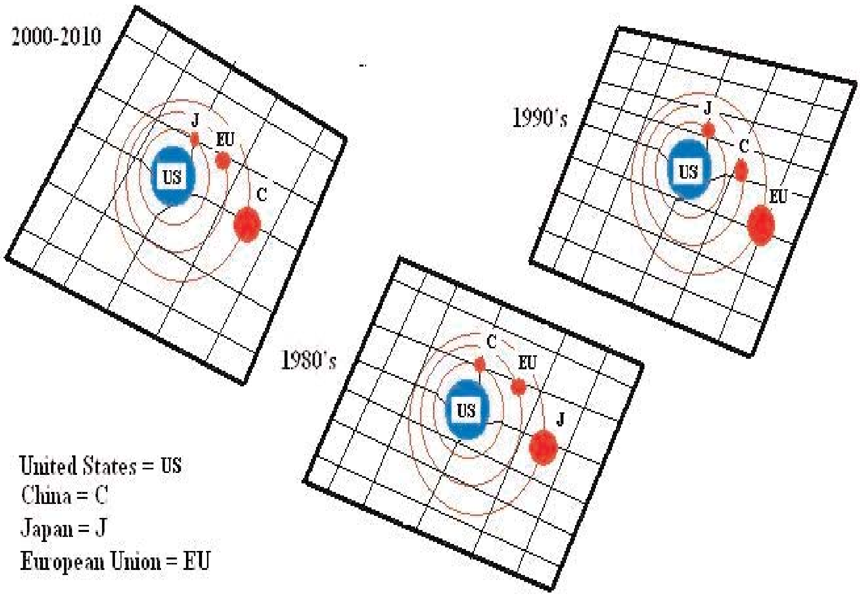

Figure 4. **The International Trade Relativity between US, EU, Japan and China**

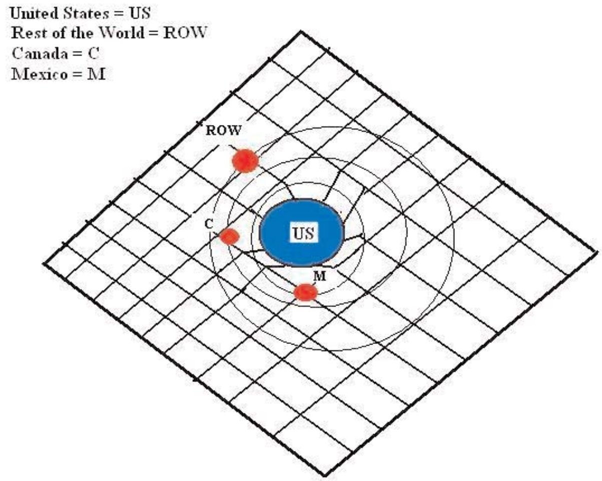

Figure 5. **NAFTA and the Rest of the World (ROW) International Trade Relativity**

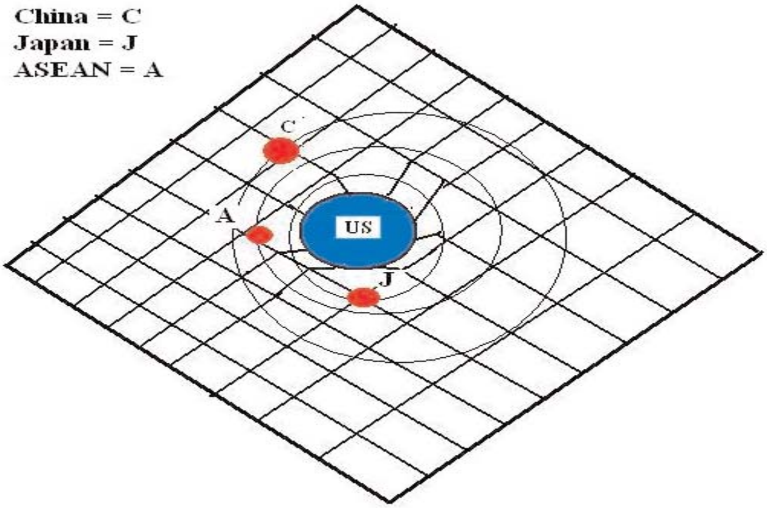

Figure 6. **US and East Asia & Southeast Asia International Trade Relativity**

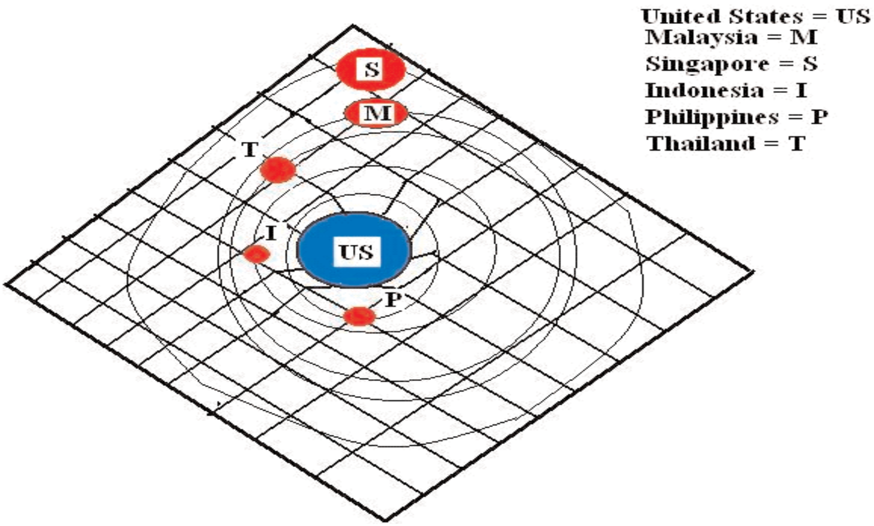

Figure 7. **US and ASEAN International Trade Relativity**

Section III: The Macroeconomic Black Holes.

3.1. Introduction. To write about the application of black holes (Wheeler, 1962) to economics is to observe how black markets can generate a negative impact on the final GDP in any country. In our case, we proxy the black markets by macroeconomic black holes. We observe how black markets can generate considerable outflow from the initial GDP. To analyze and visualize the impact of macroeconomic black holes (Figures 1 and 2) on the outflow of economic growth, we propose a new indicator on the performance of GDP. The basic premise in the construction of macroeconomic black holes depend on the "the black markets outflow circumference (BMO-Circumference)". To build the BMO-Circumference, we suggest first to find the diameter "ΘY^i" (Expression 1). It is equal to the total sum of drugs smuggling growth rate under the application of multidimensional partial differentiation in real time (ΘX_1), human smuggling rate under the application of multidimensional partial differentiation in real time (ΘX_2), mafias growth rate under the application of multidimensional partial differentiation in real time (ΘX_3), corruption growth rate under the application of multidimensional partial differentiation in real time (ΘX_4), money laundry growth rate under the application of multidimensional partial differentiation in real time (ΘX_5), prostitution growth rate under the application of multidimensional partial differentiation in real time (ΘX_6), gangsters growth rate under the application of multidimensional partial differentiation in real time (ΘX_7), tax evasion growth rate under the application of multidimensional partial differentiation in real time (ΘX_8), arms smuggling growth rate under the application of multidimensional partial differentiation in real time (ΘX_9), assaults and murders growth rate under the application of multidimensional partial differentiation in real time (ΘX_{10}), kidnapping and extortion growth rate under the application of multidimensional partial differentiation in real time (ΘX_{11}), financial speculators growth rate under the application of multidimensional partial differentiation in real time (ΘX_{12}), terrorism growth rate under the application of multidimensional partial differentiation in real time (ΘX_{13}), black markets growth rate under the application of multidimensional partial differentiation in real time (ΘX_{14}), vandalism growth rate under the application of multidimensional partial differentiation in real time (ΘX_{15}), illegal financial services growth rate under the application of multidimensional partial differentiation in real time (ΘX_{16}), financial and traders speculators growth rate under the application of multidimensional partial differentiation in real time (ΘX_{17}), natural resources predators growth rate under the application of multidimensional partial differentiation in real time (ΘX_{18}) and illegal gambling growth rate under the application of multidimensional partial differentiation in real time (ΘX_{19}) (Expression 1).

$$\begin{gathered}\Theta Y^i = \Theta\partial X_{1(t)}/\partial X_{1(t+1)} + \Theta\partial X_{2(t)}/\partial X_{2(t+1)} + \Theta\partial X_{3(t)}/\partial X_{3(t+1)} + \Theta\partial X_{4(t)}/\partial X_{4(t+1)} + \\ \Theta\partial X_{5(t)}/\partial X_{5(t+1)} + \Theta\partial X_{6(t)}/\partial X_{6(t+1)} + \Theta\partial X_{7(t)}/\partial X_{7(t+1)} + \Theta\partial X_{8(t)}/\partial X_{8(t+1)} + \\ \Theta\partial X_{9(t)}/\partial X_{9(t+1)} + \Theta\partial X_{10(t)}/\partial X_{10(t+1)} \\ + \Theta\partial X_{11(t)}/\partial X_{11(t+1)} + \Theta\partial X_{12(t)}/\partial X_{12(t+1)} + \Theta\partial X_{13(t)}/\partial X_{13(t+1)} + \\ \Theta\partial X_{14(t)}/\partial X_{14(t+1)} + \Theta\partial X_{15(t)}/\partial X_{15(t+1)} + \Theta\partial X_{16(t)}/\partial X_{16(t+1)} + \Theta\partial X_{17(t)}/\partial X_{17(t+1)} + \\ \Theta\partial X_{18(t)}/\partial X_{18(t+1)} + \Theta\partial X_{19(t)}/\partial X_{19(t+1)}\end{gathered} \tag{1}$$

Note: (t) = present period of time and (t+1) = next period of time.

Hence, the construction of the macroeconomic black holes is the following: first, we use the black markets outflow circumference on the top and bottom of a macroeconomic black hole. We assume that the top and bottom of the BMO-circumference size in the black hole is the same, and the middle part or throat size of the macroeconomic black hole is equal to 1/3 part of the original size from top and bottom BMO-circumference in the same macroeconomic black hole (Figure 8). Therefore, the BMO-Circumference of the macroeconomic black hole is equal to π (3.14159...) multiplied by the diameter "ΘY^i" (Expression 2).

$$\text{BMO-Circumference} = \pi * \Theta Y^{i} \qquad (2)$$

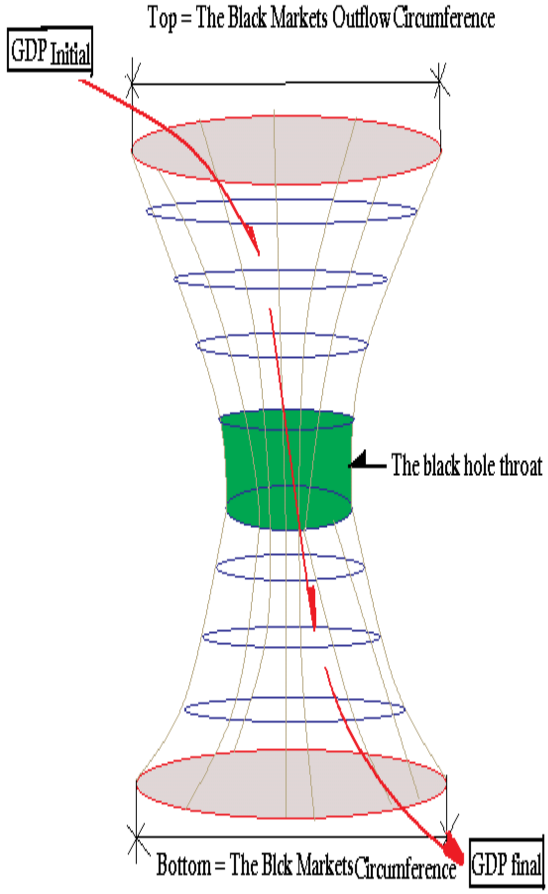

Figure 8. **Macroeconomic Black Hole Structure**

The diameter of the BMO-Circumference can show 2 possible results followed by: First, if the diameter (ΘY^{i}) is large then we can observe a huge outflow of GDP growth from the original GDP to the final GDP. On the other hand, if diameter (ΘY^{i}) is small then we can observe a small outflow from the original GDP growth to the final GDP.

However, the top and bottom circumference always keep in constant movement and sizes. It is possible based on the application of multidimensional partial differentiation in real time (Ruiz, 2009) and the application of the Omnia Mobilis assumption (Ruiz Estrada, 2011) to generate the relaxation of all the variables involved in macroeconomic black holes all the time.

Finally, when we finish building our macroeconomic black hole, it is possible to start evaluating the impact of the outflow from the original GDP to the final GDP of any country. Therefore, the final GDP is equal to the initial GDP minus initial GDP multiply by the BMO-Circumference:

$$GDP_{final} = GDP_{initial} - (GDP_{initial} \times BMO\text{-}Circumference) \quad (3)$$

According to the possible results from (3), we have 3 possible results: First, if the BMO-Circumference is large, then there exist a high possibility to have poor performance of GDP. Second, if the BMO-Circumference is equal to 0 then there is high possibility to have better performance of GDP. And the third result is that if BMO-Circumference is small, then there is high possibility to have less good performance of GDP. Our basic premise is that the size if BMO-Circumference can be controlled by strong legal framework, national security, efficient institutional control, political stability, democracy and strong regulations framework. The main idea here is that active legal, political, institutional supports play a crucial role in the control of black markets or macroeconomic black holes expansion and less outflow from the original GDP to the final GDP. Another our premise is that the problem in the economic growth and development for less developed countries (LDC's) can be originated from the huge size of macroeconomic black holes generating a large outflow from the initial GDP to the final GDP. Hence, the major factors can be the weak legal framework, controls, national security, inefficient institutional framework, political instability, limited democracy and weak regulations framework.

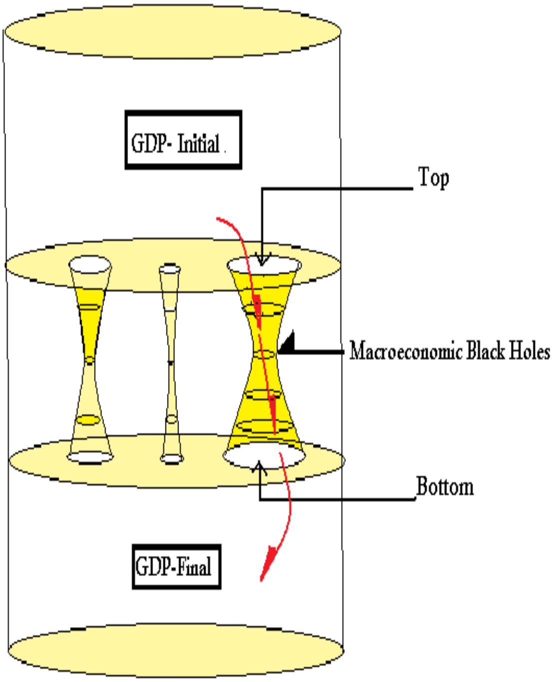

Figure 9. **The Effects of Macroeconomic Black Holes on the Final GDP**

4. Conclusion. This paper has 3 basic conclusions. Firstly, this paper concludes that the energy of economics (E) shows that keep low unemployment growth rates (U) and high and fast expansion of technological development speed (T^2) in the short and long term can generate a large amount of economics of energy (E) in any country. The second conclusion is that a large country with a constant expansion of international trade mass (D) can generate a strong international trade gravity around it by generating more international trade among traditional trade partners and the possibility to attract new international trade partners. Finally, the third conclusion is that the size of "the black markets outflow circumference (BMO-Circumference)" plays an important role in the final size of macroeconomic black holes and the subsequent outflow from the initial GDP to the final GDP in any country (Figure 9). Therefore, the size of the BMO-Circumference can be controlled under the application of suitable legal frameworks and political stability in the short and medium run.

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