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Global Warming and Economic Growth Tradeoff: A Theoretical Approach
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ABSTRACT:Global warming is an environmental theory rooted in science that explain that increase in the emission of Carbon dioxide (Co2) and other greenhouse gases may cause climatic changes that will be detrimental to human existence in over the next century. Increasing and unchecked: Global warming; depletion of the ozone layer; environmental damages caused by widespread acid rain; ultraviolet radiation; deforestation in the tropical rain forest; population and economic growth; etc have been identified as serious threat to sustainable development. Global warming and economic growth trade off issues are complex and controversial and no scientific and economic consensus has been achieved despite efforts made at Kyoto conference of 1997 and the Copenhagen conference of 2009. To reduce carbon dioxide emissions to achieve the targets of reducing global warming would mean reducing a country's industrial production likely to reduce GDP growth, debt overhang, incidence of unemployment etc among countries especially the industrialized nations of the World. The negative externalities caused by global warming are many and varied and therefore call for policy measures to internalize the negative externalities and to trade off economic growth with global warming. This require deemphasizing growth in gross domestic product through carbon emissions that is currently in practice but maintain a balance between global warming and economic growth by reducing emissions of greenhouse gases, either by reducing the level of emissions-related economic activities or by shifting to more energy-efficient technologies that would allow the same level of economic activity at a lower carbon dioxide emissions.

KEY WORDS*:* global warming, green house gas, Economic growth, Tradeoff

I. INTRODUCTION

The debate on global warming has gain more momentum in recent years due largely to threat on human existence and policy measures to mitigate it. The idea is that the emission of greenhouse gases generates a negative effect in the form of global warming that harms the society.The current debate about how much global warming should be mitigated is crucial for human survival on earth. Environmental scientists and economist have conflicting views on mitigation of global warming. The former concerns itself to reduction of carbon dioxide emission for environmental sustainability, while the latter warns the adverse effect of reduction of carbon dioxide emission on productivity and economic growth of nations and therefore advocate for measure to trade off economic growth and global warming, so that countries would be in equilibrium. Trade off between global warming and economic growth and policy measures to sustain the trade off are economic measures that react to the threat of global warming.There are speculations among scientist for the past two centuries that changing the chemical composition of the atmosphere through emission of carbon dioxide will result to global warming. S.A. Arrhenius in 1896 made an estimate that direct but not proportional relationship exist between atmospheric concentration of carbon dioxide and global temperature increase in the ratio of 2 is to 4 or 6 degrees.The atmosphere contains numerous radioactive gases that absorb radiation at various points of the spectrum. The greenhouse gases are transparent to incoming solar radiation but absorb significant amount of outgoing radiation.The debate on climate change arose as a result of atmospheric concentration of greenhouse and other gases that threaten human activities on earth. The major greenhouse gases (GHGs) as established by scientist includes: carbon dioxide, methane, nitrous oxides, and chlorofluorocarbon (CFCs). After having an explicit discussion on global warming, I shall proceed to economic growth and development.Friedman (1972) explain economic Growth in terms of an expansion in one or more dimensions of the productive system without altering the existing structure, and development is structural transformation of the social system achieved through the process of innovation. Economic growth is achieved through a sustainable and quantitative increase in the per capita output or income of a country accompanied by increase in major macroeconomic variables such as expansion in its: capital and volume of trade, consumption, labor force. Economic development has wider meaning than economic growth. It is taken to mean growth plus change. ‘

'It is related to quantitative change in economic wants, goods, incentives, institutions, productivity and knowledge or the upward movement of the entire social system''. Myrdal (1970)Economic development has both growth and decline elements embodied in it. The prevalence of poverty, unemployment, inequalities in an economy may prevent it from achieving the status of economic development due to the absence of structural and technological changes Jhigan (1997).According to Kindleberger (1965) economic growth means increase in gross domestic product while economic development implies both increase in gross domestic product accompanied by the technical and institutional variance by which goods are produced and distributed. Economic growth also means more outputs derived from greater efficiency of factor inputs, which implies an expansion in output per unit of input.Meier (1965) stated that economic development result when there is sustained increase in real per capita income of a country subject to the specification that the number of people living below the absolute poverty line does not increase and that the distribution of income does not become more unequal. This definition emphasize that for economic development to strive, the growth rate of population must be lower than the growth rate of real per capita income. Okun et al (1975) emphasized that when individuals are able to consume more goods and services, then the economy is developed. This means the income level of individuals have increase, poverty is reduce, so also is unemployment, inequality gap is narrowed, and the society is generally better off.In the 1970s, poverty, income inequalities, unemployment were identified as constraints to economic development and measures to eradicate or reduce them became government major policy. Prior to the 1970s economist opined that sustained increase in the real GNP would trickle down to the masses in the form of job creation and elimination of poverty and thus improve the standard of living of the masses. ''Problems of poverty, discrimination, unemployment, and income distribution were of secondary importance to "getting the growth job done" Todaro et al (2003). The rest of the paper is organized as follows: section two contains literature review. Theoretical framework is taken up in section three. Section four treats methodology. Trade off between Economic growth and global warming is in section five. Policy recommendations are in section six, while section seven concludes the paper.

II. LITERATURE REVIEW

Nordhaus (2010) opined that consensus on the increasing magnitude of global warming over the next century have been reached among scientist. The Kyoto and Copenhagen agreements on global warming reached in 1997 and 2009 respectively on measures to reduce the emission of greenhouse and other gases has not been implemented optimally by nations. His study examines alternative outcomes for emission, climate change and damage under different policy scenarios. He used an updated version of the RICE Model which combines the economic variables with climate change. Global warming will be more severe if policy measures aimed at abating it are not implemented. Carbon prices were also calculated in an efficient manner in his model to keep the increase in global average temperature not greater than 2^0 C. The 2010 carbon price was estimated to be 59 dollars (USD) per ton using 2005 price as base year price which compare with an effective global price of five dollars (USD) per ton. The author stressed that the Copenhagen temperature goal may not be attained despite frantic efforts by countries to realize their objectives under the Copenhagen accord.Armon et al (2009) in their study on Global warming and externalities empirically prove that global warming is caused by human activities through the emission of greenhouse gases (GHG) .The effect of this is climate change, and the fact that until recently there is neither a market price for GHG emission nor alternative institutions to impose limit on emissions worst the problem. The authors regard GHG emission as negative externality that has not been corrected. They further emphasized that attaining a balance paths in the presence of such negative externality that is not corrected might result to inefficiency: and as a consequence, there is no real economic opportunity cost to correcting this externality by mitigating global warming. Mitigating investment using resources diverted from conventional investment can raise the economic well being of both present and future generations. The authors used a simple Keynes- Ransey growth model to explain the relevance of Pareto optimality and economic efficiency as mitigation investment, and the use of the equilibrium condition necessary for modeling negative externality that has not been corrected.Smith *et* al (2001) using medium term evidence concluded, that: income inequality gap would increase among countries and in a country if climate change is not mitigated. Measured in 1990 levels, up to 2 °C, a small increase in the global average temperature would impact negatively in many developing countries but may have positive impact in many developed countries reflecting in their tradable sector. ''With high confidence, it was predicted that with a medium (2-3 °C) to high level of warming (greater than 3 °C), negative impacts would be exacerbated, and net positive impacts would start to decline and eventually turn negative'' (Smith et al 2001).According to Michael et al (2012) the negative externalities of environmental damages caused by the activities of multinational oil giants are mainly felt within the Host communities. However it is worthy to note that some of the negative effects have trans- boundary implications. Gas flaring is a contributing factor to such negative externalities in the form of global warming. Gas flaring destroys the ozone layer which is a buffer covering the atmosphere that guides against ultra violet rays of the sun.

III. THEORETICAL FRAMEWORK

The literature is replete with theories that explain the foundation and current trends on global warming.

3.1.The General theory of global warming,

A universally accepted theory of global warming depicts that carbon dioxide emission into the atmosphere is regarded as a major cause of global warming. Although the fact remains that other gases contribute to anthropogenic global warming, but carbon dioxide last longer than other gases in the atmosphere. For example, water vapor is a huge cause of global warming, but rapid precipitation removes it from the atmosphere, making only an infinitesimal impact on atmospheric gas composition that warms the earth.The concentration of carbon dioxide in the atmosphere is small but very powerful and prevents the earth from freezing. An estimated 400 parts per million of carbon dioxide in the atmosphere helps keep humans warm, and increasing its concentration in the form of burning of fossil fuel, cutting down of trees, bush burning etc makes the earth warmer, and thus result to atmospheric global warming. Complicated and integrated modeling techniques involving the use of biology of the earth, chemistry and physics, are used to determine the impact of global warming on humans. All things been equal the high concentration of carbon dioxide in the atmosphere is an indication that sea level would rose, flooding would be occurring in near future, and the prevalence of thunderous storms that will threaten life. The uncontrolled release of carbon dioxide and methane into the atmosphere will occur if certain triggers happen in the arctic region, such as melting the permafrost.

The fact remains that human productive activities are the cause of global warming is supported by various scientific findings. Different theories on global warming have been developed by research scholars to understand its determinants and how it works, the adverse effects and policies to mitigate it. Their analysis was based on variables such as temperature, greenhouse gases and climate phenomena. For example research findings shows an increase in ground temperature between 0.3 degree and 0.6 degree Celsius in last century and about 30 percent increase in atmospheric carbon dioxide.The Swedish chemist in 1896 explains that carbon dioxide and water vapor helps trap the sun's heat in the atmosphere of earth and warm the earth. He was the first scientist to put forward this theory in the 19^{th} century. According to him the burning of coal by the industrialized nations during the era of industrial revolution was the main cause of global warming. He then predicted that carbon dioxide would cause increasing temperature and also emphasized that the influence is stronger in winter than summer and greater on land than ocean.Guy (1934) asserts that fossil fuels was a major factor for global warming and the economic activities of human beings had added more carbon dioxide into the air as one degree Fahrenheit temperature had been risen in 1934 and 1980. The rising temperature results to less snow.Roger et al (1957) stated that an unquantifiable greenhouse gas is pumped into the atmosphere by humans. He advised all scientists to inquire about the quantity of gases in atmosphere. His advice led to the installing of new instrument by chemist in 1958 which for the first time successfully measure the quantity of gas in the atmosphere.

3.2.The controversial greenhouse theory on global warming.

Another global warming theory was developed at the University of Leicester (UK). The controversial theory debunked early theories that burning of fossil fuels and atmospheric carbon dioxide levels are the cause of global warming. According to Vladmir Shadurov of the Russian Academy of sciences, the sudden rise in global mean temperature experimented by scientific scholars over the last century or so could be due to atmospheric changes that are not connected to human emission of carbon dioxide from burning of natural gas and oil. Shaldurov explained that changes in the amount of ice crystals at high altitude cause damage to the layer of clouds found in the mesosphere and hence reduce the amount of warming solar radiation reaching the earth surface.Shaldurov used a model of the annual average temperature change for the preceding forty years and found out a slight decrease in temperature until the twentieth century. He suggests that the rise, which began between 1906 and 1909 could have been caused by the massive Tunguska Event which rocked a remote part of Siberia, northwest of Lake Baskal on the thirtieth June 1908.The Tunguska Event, often referred to as the Tungus Meteorite is thought to have resulted from explosion of asteroid or comet entering the earth's atmosphere which released as much energy as fifteen one- megaton atomic bombs, as well as blasting an enormous amount of dust into the atmosphere, felling 60 million trees over an area of more than 2000 square kilometers. The controversial theorist suggests that this explosion would have caused change in atmospheric structure and is responsible for subsequent rise in global temperature. Shaldurov further stressed that that only an enormous natural phenomenon such as asteroid or comet impact or airburst could cause global warming and sea levels to rise, destroying persistent ice crystals in the high altitude mesosphere.The Tunguska Event that informed Shaldurov controversial greenhouse theory could be likened to Keynesian revolutionary Theory which advocates short run measures in the form of government intervention to bring out economies severely damaged by the great depression.

Tunguska Event was just an event, and coincided with the period of time during which global temperatures appear to have been rising the most steadily in the 20th century. It provides short run explanation to global warming in the 20th century and fails to account for long run dynamics of global warming that goes beyond the events that occurred at the time of his carrying out the analysis.

3.3.The false paradigm theory of global warming

Williams did not believe in the general theory of global warming which states that carbon dioxide is a cause of global warming but believe that the atmospheric temperature has not changed over time. He further emphasized that based on his personal experience in research on climate change the amount of carbon dioxide in the atmosphere has remain the same. According to this theory, global warming and the call for mitigation measures is deceiving and mistaken.Miskolzi asserts that global warming is manmade as the earth is containing in-built safety mechanism that prevents global warming. In other words, earth has a reservoir of heat energy and an in built mechanism capable of maintain balance or equilibrium temperature when disequilibrium exist, and so there is no global warming. He regards general theory of global warming as fake and manmade.

3.4.THE CHAOS THEORY AND GLOBAL WARMING.

Another theory is the Chaotic theory and global warming founded by Lorenz (1963), emphasized that climate is chaotic and hence makes prediction difficult and inaccurate. The chaos theory was developed in a landmark paper by Lorenz that because the climate is mathematically- chaotic object was demonstrated in a simulation of fluid turbulence and ended hopes for long term forecasting and was admitted by the UN panel on climate change as correct. He posits that accurate long term prediction of future evolution of the climate is not possible by any method. He further demonstrated that at present, climate forecasts are inaccurate even in short term as little as six weeks ahead or confined to a small region of the planet.One of the defining traits of a climate system is sensitive dependence to initial conditions. ‘’This means that even very small changes in the state of the system can quickly and radically change the way that the system develops over time’’ (Lorenz 1963).

IV. METHODOLOGY

This is a theoretical paper in which the author tried to stimulate general intellectual curiosity on the persistent problems of global warming and economic growth trade off, hoping that the new and innovative strategies for attaining a trade off will emerge at the end. The paper is fundamentally enriched with internet sources and library research.

4.1.Trade off between Economic growth and global warming

Economic growth is positively related to global warming. To increase a country’s GDP would require the burning of greenhouse gases especially in resource abundant countries. This relation could be reversed by adopting environmentally friendly technology that minimizes the burning of fossil fuel. To reduce the carbon intensity of GDP, government action is needed since the market mechanism cannot satisfactorily provide measures to correct for negative externalities such as global warming. Stabilizing climate would require reductions in the levels of Industrial production and consumption is one the objectives of the “degrowth” hypothesis. The emphasis is that higher level of economic activity can be achieved through increase emission of greenhouse gas, increases GDP of countries and also consumption by house hold, firms and government. A similar argument, however, offered by proponents of free enterprise economy is that energy policies initiated by government need to put the economy on course towards the achievement of a sustainable energy system. The era of global warming has witnessed the failure of both the market and government in formulating and implementing sustainable energy policies. The production of goods and services requires energy and greenhouse gas emission and that reducing energy use or shifting toward higher-cost forms of energy would result to a reduction in the level and growth of productive output.For instance the U.S. Energy Information Administration (USEIA) affirms that her economic growth would fall and unemployment would rise if the Kyoto accord is fully implemented. It estimated a 4.3 percent reduction in economic output and about 4.9 million jobs lost. These effects played powerful anti Kyoto among countries in the implementation of the agreements.Policy makers are of the opinion that the full implementation of the Kyoto protocol would affect their economies negatively. There would be job lost to potential competitors and increasing unemployment. According to Mittnik et al. (2010), the fear of job lost and reduction in economic activities does not arise. Cross country and country specific studies shows that carbon tax and subsidy will keep economies out of fear. For instance budget-neutral green policies which tax carbon-intensive sectors and subsidize carbon-saving sectors or fund research in “green” technology generally have been identified to have positive net effects on job creation as well as achieving the goal of carbon dioxide emission reduction.

V. POLICY RECOMMENDATIONS

Aggressive, consistent and proactive Policy measures are required to discourage, stabilize or reduce total carbon emission in the next decade. This would be like performing cost benefit analysis test. The anticipated benefits of reducing carbon emission by countries should be either greater than or equal to the cost of implementing emission reduction. Theories on global warming attest to the fact that the era of industrial revolution being the cause of human activities and reducing it will have a decelerating effect on climate change. For the purpose of policy formulation, the following are recommended:

[1] Climate change may turn into a self-enforcing process. In order to reduce costs, and enjoy economies of scale, global warming should be mitigated once it has been identified as problem ''that can plague the earth''. At this initial time cost of mitigation will be cheaper as delay would be dangerous to human existence on earth.

[2] Government fiscal operation of taxing and spending should be enforced. Charging for externalities such as the polluter pay principle should be enforced. The fundamental principle here is that producers generating the pollution that cause global warming should bear the full cost of the damage caused by them. That is, the negative externalities is been directly internalized. In its broader form, this involves the offender paying to meet emissions standard, thus raising cost of producing the polluting products. The more polluting the product, the more its price will signal the fact.

[3] While the more specific form of the instrument has a very well established pedigree in economic theory, the rate of adoption of polluter charges has been comparatively slow. One of the difficulties of direct externality charge is that ideally they need to be applied across the whole range of environmental costs to be fully efficient.

[4] User- pays principle. This requires that the user of resources should pay the full social costs of supplying the resource. It is normally seen as a policy instrument for dealing with natural resources management especially with regards to agriculture and forestry. User charges are quite widespread in the application for effluent discharge by industry and residence of urban areas.

[5] The establishment of an International Fund to be known as Atmospheric Stabilization fund. Funding should not be distributed on the bases of equality among countries or industry, but on the bases of how countries contributed to the current state of global warming from the era of industrial revolution to date. It is expected that the industrialized nations contribute 80 percent of the funding while the poor and developing countries contribute 20 percent of the funding. The fund should be managed by a board of trustee made up of both developed and developing countries. Tenure of membership should be periodic and rotational. The purpose of the fund should be to enhance the development of green technology as well as to narrow the growing income gap between developed and developing countries.

VI. CONCLUSION

The debate on global warming and mitigation measures continue unabated among academic scholars. Different theories on global warming have been developed by scientist over time with different initial conditions. Some global warming theorists attribute it to the era of industrial revolution when coal was been burnt. Others are of the view that global warming was due to atmospheric changes that are not connected to Human emission of carbon dioxide from burning of natural gas and oil but changes in the amount of ice crystals at high altitude that could damage the layer of thin, high altitude clouds found in the mesosphere that reduce the amount of warming solar radiation reaching the earth.Other theorists opined that fossil fuel was the cause of global warming and Humans are responsible for it. They further emphasized that carbon dioxide is a major cause of global warming because of its longevity in the atmosphere than other gases.The effect of global warming on Humans includes but not limited to: loss of land areas including beaches and wetlands to sea level rise; loss of species and forest area; disruption of water supplies to cities and agriculture; increased costs of air conditioning; Health damage and diseases from heat waves and spread of tropical diseases; loss of agricultural outputs due to drought; disruption of weather patterns with increased frequency of hurricanes and other extreme weather events etc.The negative externalities caused by global warming are many and varied and therefore call for policy measures to internalize the negative externalities and to trade off economic growth with global warming. This require deemphasizing growth in gross domestic product through carbon emissions that is currently in practice but maintain a balance between global warming and economic growth by reducing emissions of greenhouse gases, either by reducing the level of emissions-related economic activities or by shifting to more energy-efficient technologies that would allow the same level of economic activity at a lower carbon dioxide emissions.

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