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CLIMATE CHANGE AND ECONOMIC DEVELOPMENT: WHAT MODEL OF DEVELOPMENT IN THE FACE OF THE EFFECTS OF CLIMATE CHANGE?

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ABSTRACT

Climate change has become a central issue for any vision that deals with the issue of economic and social development. Thus, controlling the potential effects of climate change has become a priority for any strategy or action aimed at economic and social development. So, the question that arises is: How to adjust between having economic development and mitigating the effects of climate change. Through this work, we have tried to present a new model of economic growth and development by introducing the climatic factor as a central explanatory component of economic development. Thus, based on the Solow model with technical progress and introducing the economic cost relating to the effects of climate change, we have arrived at a model that explains development by four investment rates, namely the investment rate in capital, the rate of investment in labor (human capital), the rate of investment in technical progress and the rate of investment in green economic activities. Thus, these converge with the theories that advocate that investment is the driving factor of all economic growth.

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INTRODUCTION

Development is the fact of growing, progressing, and transforming oneself positively over time. Economic development means positive structural evolutionary transformations that a geographical area or a population has experienced over time in its various fields: agricultural, industrial, technical, demographic, health, cultural. The question of development is old. It has flowed too much ink according to different visions and approaches. Indeed, the old visions, by dealing with economic development, vocalized their work on the issue of economic growth. On the other hand, the notion of development appeared with the decolonization movements. So, from the 1950s, the progress paradigm was linked to development and technical progress became the main target of any country seeking to develop. Furthermore, controlling the potential effects of climate change has become a priority for any strategy or action aimed at economic and social development. So, climate change has become a central issue for any vision that deals with the issue of economic and social development. In other words, controlling the potential effects of climate change has become a priority for any strategy or action aimed at economic and social development. Thus, the question that arises is: How to ensure sustainable development in the presence of the potential effects of climate change (CC)?

In seeking to answer this question, we try to present a new model of economic development by introducing the climate component as an explanatory variable of sustainable development. Thus, our model is based on the first theoretical models of economic growth and is inspired by the principles of new models of economic development.

The theoretical foundations of the model: Classical theories believe that the economy, in the long term, will reach a steady state, and consider investment to be the essential factor in all economic growth. Thus, agents must save more to invest more. For this vision, consumption is only a residue of income after savings and economic growth therefore depends on the distribution of income between the factors that contribute to it. The classics defend the idea that the more the capitalists receive a large share of the profit, the more they will invest, the greater the growth will be. Thus, for Ricardo, the national income is divided between three social classes: the owners, the workers and the capitalists. For a given cause, a reduction in the share of profit intended for the capitalists will necessarily lead to a drop in investment. And when the latter cancels out, production stagnates and the economy reaches its steady state. Ricardo thinks that an opening of the borders can delay this situation of stagnation. Furthermore, Malthus explains the steady state situation via the law of population. The latter advocates that the needs of the population and the resources for its subsistence do not grow with the same speed. The former progress according to a geometric sequence and the latter progress

according to an arithmetic sequence. So, this usually causes an overcrowding situation. Malthus suggests that adapting moral constraints can overcome this problem. Furthermore, Keynes believes that demand is the driving factor of short-term economic growth. Against the classics, Keynesian thought advocates that short-term state intervention is necessary to stimulate demand in order to bring the economy out of underemployment. This idea was reaffirmed for the long term by Harrod (1939) and Domar (1947) arriving at the same conclusions put forward by Keynes. Thus, for them, in the long term, growth is unbalanced and imbalances are cumulative, so state intervention is required to ensure long-term balanced growth by stimulating aggregate demand. Against the Keynesian view, in 1956 Robert Solow advanced the first neoclassical model of long-term economic growth. This model is based on the assumption of a decrease in the marginal productivities of the factors of production. And he advocates that in the absence of technical progress the economy converges towards a stationary state. For Solow, technical progress is the driving factor of long-term economic growth. However, the latter is assumed to be exogenous to the behavior of economic agents.

The fall from the sky of technical progress constitutes the fundamental limit of the Solow model. Then, new theories came to explain the origin of technical progress. Indeed, endogenous growth theories advocate that there is a reciprocal relationship between technical progress and economic growth by suggesting that technical progress generates economic growth and is also generated by it. In this sense, human capital (Robert Lucas), research and development and innovation (Paul Romer), investment (Robert Barro), are therefore the main factors explaining the origin of technical progress. Historically, the notion of development appeared with the decolonization movements triggered at the end of the Second World War. From the 1950s, the progress paradigm was linked to development and technical progress became the main target of any country seeking to develop. Economic development has become like the transition from one state to another accompanied by positive transformations in all areas: technical, economic, social, institutional and cultural. Moreover, the diversity of the origins of authors has influenced their angle of vision towards the question of economic development, which has contributed to the birth of various theories of development. According to the vision of the North, theories have treated the problem of development as a question of catching up, ie how the underdeveloped countries can catch up with the developed countries. The industrial countries of this period therefore become the model to be achieved (Rostow) and other theories have linked underdevelopment to the question of poverty.

Indeed, according to R. NURSk “a country is poor because it is poor”. For him, the economy of a poor country is characterized by a lack of resources and therefore a weakness in terms of savings, which necessarily leads to low income and therefore low domestic demand and this loop continues indefinitely. So a vicious circle of poverty produces a chain of vicious circles of poverty too. Proponents of this thought suggest that borrowing from outside is the main factor in pushing savings up and therefore increasing investment in order to break out of these vicious circles. In addition, the theories of development through openness inspired by Ricardo's theory of comparative advantages have pinpointed international trade as the driving factor of the country's development. This theory has been put into practice by the Bretton Woods institutions: the IMF, the World Bank and the WTO.

Moreover, according to the vision of the north, the dependentist theories see that the main cause of underdevelopment is the transfer of the economic surplus from the countries of the south to the countries of the north (Samir Amin). Thus, the countries of the North remain the model to be achieved, but the means is to break the unequal relations between the south and the north. In addition, the theory of human development put forward by the UNDP, in particular by the Indian author Amarty Sen, has widened the field of definition of development to encompass aspects other than the economy, namely education and health. The composite human development indicator “HDI” becomes the main index for classifying and categorizing countries according to the degree of their development.However, in 1987, the UNO advanced the concept of sustainable development, defining it as development that meets the needs of the present without compromising the ability of future generations to meet theirs. Thus, the environmental aspect becomes such a factor to explain any development. In 1992, the Earth Summit in Rio, held under the aegis of the United Nations, formalized the notion of sustainable development and that of its three pillars, economy, ecology and social. So, sustainable development must be an economically efficient, socially equitable and ecologically sustainable development.

The foundations of the presence of the climatic component in the economic development model: Undoubtedly, climate change has become a reality. Indeed, over the past 50 years, the world has experienced an increase in the frequency and intensity of occurrence of extreme weather events, including droughts, floods, tsunamis, and storms. Thus, the evolution of the average temperature of our planet has recorded an upward trend and the precipitation regime has been modified with a downward trend, particularly in arid zones. These climatic fluctuations have had adverse effects on all human activities and in particular activities that are linked to the climate in most countries and in particular in poor countries. Thus, the issue of climate change has become a central issue for any vision that deals with the issue of economic and social development. In other words, controlling the potential effects of climate change has become a priority for any strategy or action aimed at economic and social development. Therefore, taking into account the climate component in the growth and evolution of economic and social progress makes it possible to optimize the mobilization of existing resources in order to meet the needs of current generations and without exhausting or affecting those of future generations.

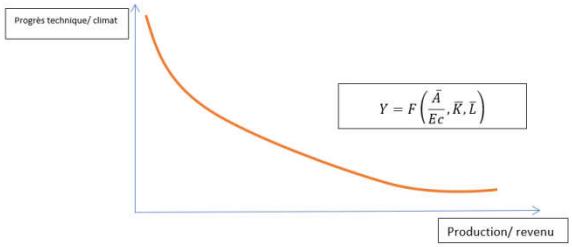
However, sustainable development and controlling the effects of climate change are becoming two sides of the same coin. Thus, it is clear that the effects of climate change affect economic and social growth and development and vice versa. Thus, the climate component can generate new opportunities such as technological innovations, new adaptive alternative solutions to climate change, and new green jobs. Then, developing countries can exploit their comparative advantages, particularly in terms of renewable energies, to position themselves well in the new global market for green goods and services. Climate change is expected to lead to a significant reduction in global production and productivity. Indeed, according to IPCC experts, the effects of climate change will continue to manifest themselves, and will even become more and more important in the years to come. Thus, climate change should lead to a significant reduction in global production and productivity, which could reach 20% of economic production, particularly in the sectors of agriculture, fishing and tourism. In addition, many regions will face water scarcity, increased ecosystem degradation and significant and rapid loss of biodiversity.
So, the consequences of climate change are and will not only be economic and environmental but also social, loss of human life, famine, disease, destruction of infrastructure, migration, conflict….

Presentation of the new model of growth and economic development: By referring to the Solow model with technical progress, and by introducing the climatic component, we can write our new model of economic development as follows:

$$Y = F\left(\frac{A}{Ec}, K, L\right)$$

With :
Y: economic national income;
A: technical progress;
Ec: climate component cost “Emission of greenhouse gases”;
K: the quantity of capital;
L: the quantity of work;

V- Graphic representation of the production function



Suppose that the quantities of factors of production are unchangeable and that technical progress is constant. Then the real economic production is a decreasing function of the climatic component (economic cost relative to the effects of CC). Thus, if the latter tends towards 0 (i.e. low quantity of greenhouse gas emissions), then the national economic income tends towards plus infinity.

The economic growth rate

Consider the following economic national income function:

$$Y = F\left(\frac{A}{Ec}, K, L\right)$$

The partial derivative of this function with respect to the time factor gives us the following:

$$\frac{dY}{dt} = \frac{dY}{dK}\frac{dK}{dt} + \frac{dY}{dL}\frac{dL}{dt} + \frac{dY}{dA}\frac{dA}{dt} - \frac{dY}{dEc}\frac{dEc}{dt}$$

So, calculating the economic growth rate by dividing both sides of the previous formula by Y which gives the following formula:

$$\frac{\frac{dY}{Y}}{dt} = \frac{dY}{dK}\frac{1}{Y}\frac{dK}{dt} + \frac{dY}{dL}\frac{1}{Y}\frac{dL}{dt} + \frac{dY}{dA}\frac{1}{Y}\frac{dA}{dt} - \frac{dY}{dEc}\frac{1}{Y}\frac{dEc}{dt}$$

By transformation weget:

$$g = \frac{\frac{dY}{Y}}{dt} = \frac{dY}{dK}.\frac{K}{Y}\frac{\frac{dK}{K}}{dt} + \frac{dY}{dL}.\frac{L}{Y}\frac{\frac{dL}{L}}{dt} + \frac{dY}{dA}.\frac{A}{Y}\frac{\frac{dA}{A}}{dt} - \frac{dY}{dEc}.\frac{Ec}{Y}\frac{\frac{dEc}{Ec}}{dt}$$

g: the rate of economic growth

$\frac{dY}{dK}$: the marginal productivity of capital (rate of profit)

$\frac{dY}{dL}$: the marginal productivity of labor (wage rate)

$\frac{dY}{dA}$: the marginal productivity of technical progress (rate of investment in technical progress)

$\frac{dY}{dEc}$: the economic marginal productivity of the climatic component. (Economic cost rate of CC effects)

$\frac{K}{Y}$ and $\frac{L}{Y}$ Are respectively the coefficient of capital and the coefficient of work.

$\frac{A}{Y}$ and $\frac{Ec}{Y}$ Are respectively the coefficient of technical progress and the coefficient of economic cost relating to CC.

$k = \frac{\frac{dK}{K}}{dt}$ is the growth rate of capital

$n = \frac{\frac{dL}{L}}{dt}$: the labor growth rate

$r = \frac{\frac{dA}{A}}{dt}$: the growth rate of technical progress

$e = \frac{\frac{dEc}{Ec}}{dt}$: the growth rate of the economic cost of CC

$U = \frac{dY}{dk}\frac{K}{Y}$: share of capital income in national income

$Q = \frac{dY}{dL}\frac{L}{Y}$: share of labor income in national income

$P = \frac{dY}{dA}\frac{A}{Y}$: share of income from technical progress in national income

$V = \frac{dY}{dEC}\frac{Ec}{Y}$: the share of economic cost in national income

This allows us to write the growth rate formula as follows:

$$g = (k\,.U + n\,.Q) + (r.P - e.V)$$

According to this formula we find that the growth rate is equal to the sum of the growth rate of capital, the growth rate of labor and the growth rate of technical progress minus the growth rate of economic cost relating to the effects of CC.

Moreover, we know that the growth rate of capital is only material investment and in infrastructure (acquisitions of production goods, construction of infrastructure), so by the same reasoning we can approach:

- The rate of growth of work to the rate of investment in the quality of education, training, investment in the quality of health and investment in citizenship noted
- The growth rate of technical progress to the rate of investment in scientific research and innovations;
- The growth rate of economic cost to the rate of investment in the green economy.

So,

$$g = \frac{\Delta I_c}{I_c} + \frac{\Delta I_t}{I_t} + \frac{\Delta I_p}{I_p} + \frac{\Delta I_{ev}}{I_{ev}}$$

So, the question of development is a question of investment. However, to invest it is necessary to save according to the classical vision and/or to stimulate demand according to the Keynesian vision. So, the question arises why countries with means and resources and are still in a situation of poverty or underdeveloped. So, we recommend that the efficiency and optimization of the allocation of resources to the various forms of investment mentioned above in a healthy political climate and an independent judicial system can ensure economically efficient, socially equitable and ecologically sustainable development.

Conclusion

In this work, we have tried to present a new model of economic growth and development by introducing the climatic factor as a central explanatory component of development. We based our model on old theories of economic growth (classical vision, Keynesian vision, neoclassical vision) and we drew inspiration from new theories of development (theory of human development and theory of sustainable development). Thus, based on the Solow model with technical progress and introducing the economic cost relating to the effects of climate change, we have arrived at a model that explains development by four investment rates, namely the investment rate in capital, the rate of investment in labor (human capital), the rate of investment in technical progress and the rate of investment in green economic activities. Moreover, these results converge with the theories which recommend that investment is the driving factor of all economic growth. Through this model we try to enrich the global debate on the issue of economic development and climate change. Thus, we plan to test this model empirically for developing and developed countries.

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