

Neoclassical stochastic economic growth model: An application to the Bolivian economy**Modelo de crecimiento economico neoclasico estocastico: Una aplicación a la economia boliviana**

ARI-RAMIREZ, Edwin*† & MAMANI-CONTRERAS, Moises

*Universidad Mayor Real y Pontificia de San Francisco Xavier de Chuquisaca, Facultad de Contaduría Pública y Ciencias Financieras, calle Grau N° 117, Sucre, Bolivia*ID 1st Author: *Edwin, Ari-Ramirez*ID 1st Coauthor: *Moises, Mamani-Contreras*

DOI: 10.35429/JMME.2020.6.4.6.10

Received March 19, 2020; Accepted June 30, 2020

Abstract

The following project is to consider a neoclassical model. To see the grow in one-sector a continuous-time of Ramsey-type with an utility and production function. Where each component are exposed in exogenous shocks. The corresponding dynamics are represented by stochastic differential equations. Equations are solved explicitly maximizing the average, the utility level that it has by consumption. In particular, Bolivia's economy, the period of analysis and the equations that describe the behaviour or long-term trajectory of real PIB, Gross Fixed Capital Formation. The total population is considered as a labor force and the optimal consumption. As a result, we presented the equations that were found through simulations to use mathematical software Mat Lab, making some replicas observed in panel data in Bolivian's economy. Which represents fluctuations and long-term growth of the economy? To investigate the fluctuations and the economic growing in Bolivia, with the model neoclassic in a large period.

Resumen

El siguiente proyecto es considerar un modelo neoclásico. Ver el crecimiento en un sector un tiempo continuo de tipo Ramsey con una función de utilidad y producción. Donde cada componente está expuesto a choques exógenos. Las dinámicas correspondientes están representadas por ecuaciones diferenciales estocásticas. Las ecuaciones se resuelven maximizando explícitamente el promedio, el nivel de utilidad que tiene por consumo. En particular, la economía de Bolivia, el período de análisis y las ecuaciones que describen el comportamiento o trayectoria de largo plazo del PIB real, Formación Bruta de Capital Fijo. La población total se considera fuerza de trabajo y consumo óptimo. Como resultado, presentamos las ecuaciones que fueron encontradas a través de simulaciones para utilizar el software matemático Mat Lab, realizando algunas réplicas observadas en datos de panel en la economía boliviana. ¿Qué representa fluctuaciones y crecimiento a largo plazo de la economía? Investigar las fluctuaciones y el crecimiento económico en Bolivia, con el modelo neoclásico en un gran período.

Citation: ARI-RAMIREZ, Edwin & MAMANI-CONTRERAS, Moises. Neoclassical stochastic economic growth model: An application to the Bolivian economy. *Journal- Macroeconomics and monetary economy*. 2020. 4-6: 6-10

* Correspondence to Author (e-mail: ed_mat@hotmail.com)

† Researcher contributing first author.

Introductionn

The study of economic growth turns out to be one of the fundamental pillars for the development of a country, since this translates into raising the standard of living of its inhabitants, and growth is not an option to improve the standard of living, if not a necessity to maintain it. Without growth, economic structures become rigid, progressively deteriorating the quality of life of individuals.

Regarding the theory of growth, Smith (1776), Ricardo (1817) and Malthus (1798) were the first to orient their main concerns around natural resources such as land, population growth, productive capacity, trade and the expansion of the economy emphasizing the role of supply, all of them as fundamental determinants of economic growth. Later, the process of capital accumulation and ownership of the means of production was the center of attention within the growth theory, taking productivity erogenously.

Later, the theory evolved and exogenous growth models emerged thanks to the contributions of Ramsey (1928), Cass (1965), Koopmans (1965), Domar (1946), Solow (1956) and Swan (1956), from to consider population growth and productive capacity as predetermined variables and to use income, interest rate, marginal propensity to save, capital and labor as essential factors of growth. Technological progress was first introduced to growth analysis by Harrod (1939) through a production function with constant marginal product of capital, while Arrow (1962) did so by introducing knowledge and learning as the main cause of technological change.

For his part, Uzawa (1965) showed that technological change can occur through an increase in labor efficiency, which does not depend on the amount of capital used in the production process, as part of technological knowledge and can be modified for education, health, infrastructure and for the consumption of public goods.

The theory of growth followed its course and, in the eighties, endogenous growth emerged through Romer (1986) and Lucas (1988) who considered technological change as a process that explains the modifications in the production conditions of companies based on qualitative or quantitative changes in inputs, such as the stock of knowledge, human capital or skilled labor, which generates economic growth.

For its part, the Neoclassical model of economic growth developed by Solow (1956), Ramsey (1928), Cass (1965) and Koopmans (1965), has provided economists with a complete articulated economic system in which to analyze both economic growth and economic growth. such as economic fluctuations related to cycles, without making important detachments from conventional microeconomic analysis. The neoclassical model in its stochastic version presented in their seminal work by Merton (1975), Malliaris and Brock (1982) has not only been the theoretical framework of the main focus in the modern study of business cycles, but has also become the theoretical framework of macroeconomic analysis accepted in a significant number of economic research areas.

The Neoclassical model of economic growth under uncertainty has become the new paradigm of macroeconomics. The model provides economists with a theoretical framework in which to study business cycles or short-term economic fluctuations and economic growth in an integrated way.

For many years, economists interpreted short-term economic fluctuations as the result of transitory shocks associated with changes in monetary and / or fiscal policy. Shocks were thought to be propagated by the economic system, generating persistence patterns and co-movements between the different macroeconomic variables. On the one hand, the theory of business cycles would emerge, which would be dedicated to the analysis and interpretation of economic fluctuations in the short term. On the other, there would be the theory of economic growth, in charge of studying the behavior of economic variables in the long term. Traditionally, it was considered that the isolated study of the behavior of the variables in the short and long term was fully justifiable, since it was believed that there was little relationship between these two components of the macroeconomic variables.

The traditional interpretation of economic fluctuations has been seriously questioned by many researchers since the publication of the work of Nelson and Plosser (1982). These authors presented empirical evidence that supports the hypothesis that a significant number of macroeconomic variables are characterized by having a unit root in their time series. This would mean that macroeconomic variables have a stochastic and non-deterministic trend as traditionally interpreted, whose fluctuations can dominate their behavior in the short term.

Materials and methods

This research work has the characteristic of being a theoretical research; In this regard, Alfredo Tecla (1980) affirms the following, “the theoretical investigations directed to an end in which the problems have to do with the theoretical problems already formulated: their efforts can be directed towards the critical study of the solutions previously proposed, to the modification, precision or empirical verification of the laws, theories and hypotheses accepted in science”.

In the development of any science this form of research plays a very important role. In this sense, a dividing line is drawn here between verified and hypothetical knowledge and awareness of new problems is made; and new growth points. Without this form of investigation, fundamental theoretical investigations would not be possible in science.

Kind of investigation

The type of research used in the work is non-experimental since economic growth is analyzed through observations that belong to longitudinal studies or time series.

According to the scope, the following research is characterized by being an explanatory study, because it is intended to explain the evolution of economic growth in Bolivia in the mentioned study period.

According to the approach, this research is quantitative, so the empirical evidence of the neoclassical model for the Bolivian economy is evaluated, where the available information on Bolivia's GDP and other variables under study are collected and analyzed.

Methodological Strategy Research methods

The research methods that will be used in this research work are deduction and induction; The deduction due to the fact that the affirmation of the neoclassical model will be taken as a general reference to apply to the empirical analysis of the Bolivian economy for the period 1988 - 2011.

While the inductive method will be used, because based on the results achieved as a product of the empirical evidence of the relationship between economic growth and the main determinants of the economy.

As complementary research methods, analysis and synthesis will be used, due to the fact that the time series information will have to be examined by means of tables and graphs.

Statistical method, It is one of the methods generally used in the analysis of information, not only primary, but also secondary, in the form of averages, summaries and graphs that present the information in a clear and synthesized way.

Modeling method, this method is important since to evaluate the economic growth of Bolivia, the growth models that have emerged in recent decades are used.

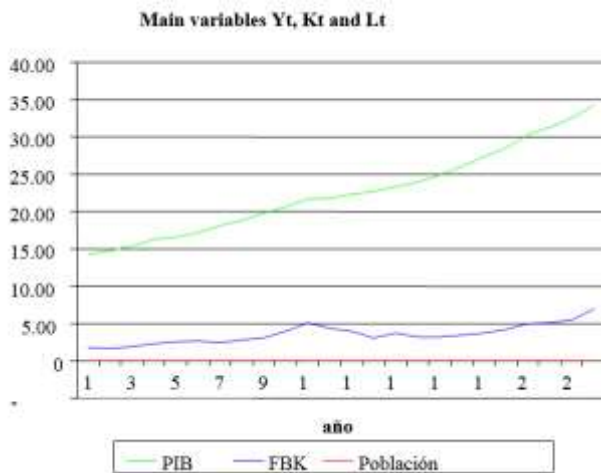
Research techniques

In this work, research techniques will be used to compile time series information (historical series), which will be obtained from institutions that record macroeconomic information, (INE, UDAPE, BANCO CENTRAL, CEPAL and others.); Econometric techniques referred to regression and correlation analysis will also be used to verify the interdependence between variables.

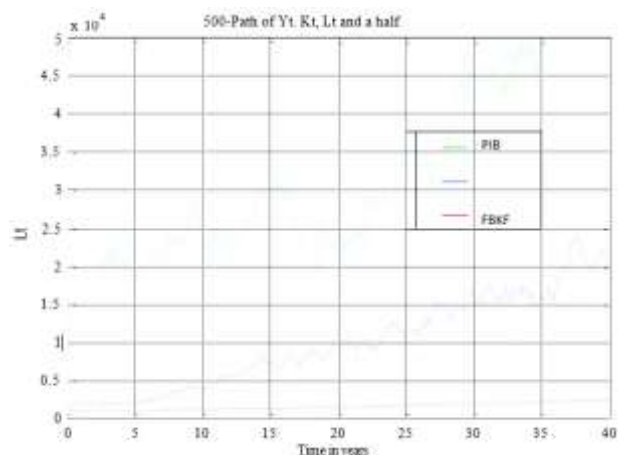
Results and Discussion

As can be seen in the figure, the evolution of macroeconomic variables from panel data in the period 1988-2011, which is equivalent to 24 years analyzed with EXCEL, has similarities with that obtained in graph (1), which is generated by the behavioral equations of real GDP, gross fixed capital formation, and population.

The simulation seems to replicate the data of the variables under study of the Bolivian economy, where it shows greater fluctuations in the trajectories of GDP and FBKF and not in the evolution of the total population, this seems to be consistent with the real data observed since according to GDP and FBKF log data show higher fluctuations while population growth is less fluctuating which means that the population growth rate is growing steadily.



Graph 1 Main variables Yt. Ktv Lt



Graph 2 500-Path of Yt. Kt, Lt and a half

Conclusions

Based on an endogenous growth model, with constant marginal productivity of capital, decreasing marginal returns, constant returns to scale and agents with infinite life and a given technique to produce, it has been possible to establish the economic growth model subjected to environments of uncertainty.

Establishing formulas for the main macroeconomic variables that describe long-term behavior. Based on data collected from the INE for the period 1988-2011, the parameters that determine economic growth in Bolivia have been estimated, which allowed the establishment of behavioral equations that describe the long-term evolution of macroeconomic variables such as real GDP, training gross capital, consumption and total population. Finally, it has been possible to represent the behavioral equations through simulations carried out with MatLab mathematical software in which it was observed that the simulation of the series seems to replicate the trajectories of the data in the product variables, FBKF and the population, but the trajectories behave in a random way whose interpretation must be probabilistic.

Acknowledgments

The researchers thank the Directorate for Science and Technology Research (DICYT) of the San Francisco Xavier de Chuquisaca University for the support provided in the development of this work.

References

Arbeláez L. Javier; Carcamo C. Ulises. Cálculo estocástico para aplicaciones a modelos económicos. Semestre Económico, vol. 7, núm. 14, julio-diciembre, 2004, pp. 129-147. Universidad de Medellín Colombia. Disponible en: <http://redalyc.uaemex.mx/src/inicio/ArtPdfRed.jsp?>. Consulta 15 de julio de 2011.

Berkeley 2005. Disponible en: <http://math.berkeley.edu/~evans/SDE.course.pdf>. Consulta 15 de julio 2011.

Cupé, E., J. Escobar, M. Mariscal y F. Rojas, (1995). "Estimación del Acervo de Capital Físico en Bolivia: 1988-1992", *Revista de Análisis Económico* 13, UDAPE, Bolivia.

Diferenciales estocásticas. Dpto. de Matemática, FCEyN, UBA.2005. Disponible en <http://mat.dm.uba.ar/~jfbonder> o <http://mat.dm.uba.ar/~pgroisma>. Consulta 15 de julio 2011.

Fernández Bonder Julián y Groisman Pablo.
Explosiones en ecuaciones

Jones Charles I. Introducción al crecimiento
económico. Ed. Prentice Hall. Mexico, 2000

Hernandez Sampieri Roberto, Fernandez C.
Carlos, Baptista L Pilar. Metodología de
la Investigación. Ed. McGraw-Hill
Interamericana. 1999.

Oliver Planchar. Macroeconomía. Prentice Hall.
Abril 2000

SACHS, Jeffrey. "Macroeconomía en la
Economía Global". Ed. Prentice Hall
Hispanoamericana. México 2002.

TECLA, Alfredo. 1980. "Metodología de las
Ciencias Sociales". México. Ed. Taller Abierto.
Tomo II. Evans L. C. An introduction to
stochastic differential equations. Department of
Mathematics, UC

Vargas José P. Mauricio (2010). ANÁLISIS
DEL CRECIMIENTO Y CICLOS
ECONÓMICOS: UNA APLICACIÓN
GENERAL PARA BOLIVIA. *Revista de
Análisis*, Julio - Diciembre 2010, Volumen N°
13, pp. 9-47