THE EDUCATIONAS A DETERMINANT FACTOR IN ECONOMIC GROWTH. THE ECUADORIAN CASE (1960-2019)

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Abstract:

This paper studies the factors driving the Ecuadorian economic growth through the analysis of the education relevance measured as human capital for the period 1960-2019. By providing a characterization of the business cycle in Ecuador we were able to describe the economic growth trend, cyclical component and also the expansions and recessions periods. To this end, we also analyzed the labor share in the economy to observe the evolution of human capital importance in the income distribution.

Secondly, a multiple regression model was designed to quantify the correlation between the economic growth rate and the evolution of human capital. The main findingsare that human capital and commodity prices have been relevant in explaining the economic growth, i.e., are the main source of increase in the GDP. To complement the analysis ant to stablish the importance of public policies for the betterment of education, a theoretical framework was designed to identify how the government spending and investment in education contribute for the human capital to increase over time.The results show that both government spending and investment are strongly correlated to increases in human capital index.

Finally, we performed a statistical growth accounting exercise to quantify the relative importance of the different factors explaining output growth: inputs accumulation (extensive growth) and technological progress (intensive growth). By decomposing the labor between increase in workers and improving of human capital human capital we can isolate the effects of education in economic growth.

Thus, for the period 1960-2019, for the Cobb-Douglas aggregate production function the average contribution of capital and labor were1.66%and 1.53% respectively points to the average annual output growth of 4.04%, whilehuman capital is accountable for 0.43%.It is also noticeable that TFP has been responsible for 0.40%, almost the same amount of the human capital. On the other hand, the augmented production function indicates that the isolated contribution of human capital was 0.25, while capital and labor were 1.14% and 1.26% respectively.The results obtained confirm the importance that the accumulation in physical capital and employment had played in explaining per capita output growth during the last decades, whereas the contribution of total factor productivity has been more modest. Human capital has also been a relevant factor in explaining the evolution of production, precisely because it is a developing economy that started from lower levels of human capital.

Keywords: *Education,Human Capital,Cyclical fluctuations, Economic growth*

1. Introduction

The study of business cycles has its origins in the pioneering work of Burns and Mitchell (1946). Subsequently, two of the works that have had the greatest impact and became important references are those of Lucas (1977) and Kydland and Prescott (1990). These initial works have given rise to an extensive literature, both theoretical and empirical, focused on the study of cyclical fluctuations, which have become one of the main topics of macroeconomic analysis. Business cycles are defined as fluctuations in economic activity around a trend that indicates its long-term path. A business cycle can be characterized by different phases. For this reason, it is important to determine the causes of these fluctuations, as well as the interrelationship between the main macroeconomic variables according to their short- and medium-term dynamics. One of the main characteristics of the business cycle is that the fluctuations observed in the level of activity do not present any regular pattern, making it complex to determine the duration and amplitude of these movements. This means that the different cyclical phases through which an economy passes do not have a similar duration nor are they homogeneous, although they tend to repeat themselves over time. The cyclical behavior of economies is a widely known phenomenon, although there is still not adequate knowledge of the facts that produce it, nor of its propagation mechanisms. Interest in the study of cyclical fluctuations in the economy has fluctuated over time, as has its own behavior. Thus, there have been periods in which economists were very interested in the business cycle and it was the fundamental research topic, with periods in which there has not been the slightest interest in its study, either because they were not considered relevant or because the economy showed great stability.

In the empirical study of business cycles, the first problem is how to obtain the cyclical component and separate it from its trend component. The problem is that, depending on the method used, the cyclical characteristics identified for the different series may vary. (Canova, 1998). Traditionally, cycle and trend were analyzed separately. Thus, cyclical fluctuations would simply be short-term deviations from a deterministic long-term trend. This view was abandoned after the important work done by Nelson and Plosser (1982), who analyzed the nature of a set of macroeconomic time series and could not reject the existence of a unit root in most of them, in this sense, the first theoretical developments of the real business cycle (RBC), which were motivated by the results obtained by Nelson and Plosser, were carried out by Kydland and Prescott (1982), Long and Plosser (1983), King and Plosser (1984) and Hansen (1985). These authors work with the idea that shocks and fluctuations in real variables were caused by persistent real supply shocks associated with technological progress. These shocks generate fluctuations in relative prices to which rational agents respond through their intertemporal choices. The main policy implication derived from this approach is that the existence of fluctuations in the level of output does not imply that markets are not in equilibrium, so the government should not attempt to reduce these fluctuations through stabilization policies. Certainly, the study of cycles is an analysis of undoubted interest for a wide range of reasons, and it is also a key element in economic forecasting.

Economic growth with significant increases in production, as indicated by Bongers and Torres (2020), is a relatively recent phenomenon. Average annual increases in production of around 2% represent a trend that has only been observed since the Industrial Revolution, initially occurring in a limited number of countries and with more moderate growth rates, and becoming more intense and widespread during the second half of the 20th century. This change in economic growth has led to consider technological progress as the fundamental engine of production growth over time. In the case of Ecuador, this technological progress has been limited due to the low level of industrialization existing in the country, caused fundamentally by the primary export growth model of the economy, which has gone through stages strongly marked by the different "booms" in the prices of export commodities. Among these products that sustained exports at different stages, we have: cocoa during the nineteenth century, bananas during more than the first half of the twentieth century and since 1973, oil. In this sense, the process of accumulation of physical capital and improvement of industrial processes gained strength from oil production. It is also notable how the human capital in Ecuador has not developed accordingly to the necessities of an economy in expansion, causing economic activity to mainly focused on labor extensive sectors, especially agriculture.

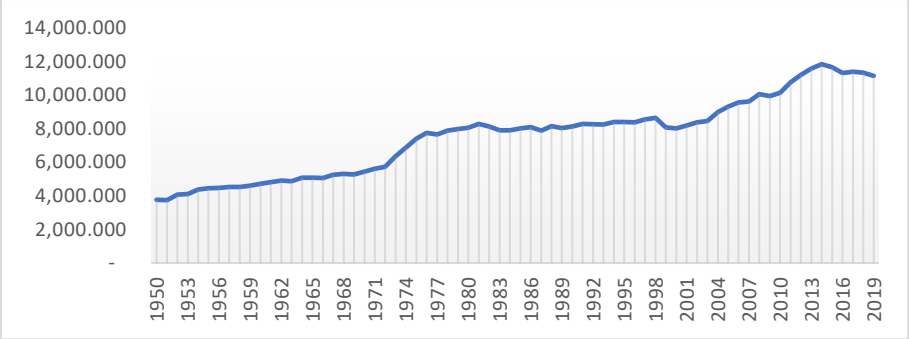

Figure 1. GDP per capita evolution in Ecuador

As we can see in Figure 1, the evolution of per capita production shows an exponential trend. There is, therefore, a clear pattern of progressive acceleration in the growth rate of per capita production over time, although not free of great variability. We find periods of decline in the level of per capita output, along with other periods of intense growth. The average growth during the period analyzed was 1.63%.

The behavior of developing countries tends to be uneven, with economies that have gone from very low levels of per capita income to levels comparable to developed economies in a relatively short period of time, as is the case of some Asian economies (South Korea, Taiwan), while other economies have made very poor progress, and only in recent decades have they reached more significant levels of per capita income (Ecuador).
One explanation for this phenomenon, in addition to the acceleration in growth rates over time, is that economic growth is based on a cumulative effect (exponential growth), given that the growth of one period is applied to the level resulting from growth in past periods. This means that when observing the evolution of an economy's GDP per capita, an exponential trajectory results between the current level of production and the initial one, if the average growth rate has been positive. This process is due to the fact that, if we apply a growth rate to a very small quantity, the result is also a small number, but if the same rate is applied to a large number, the result is also a large number.

In this sense, the purpose of this paper is to analyze the importance of human capital explained by public spending in education in explaining the evolution of the GDP in Ecuador from 1960 to 2019. The paper is organized as follows. Being chapter one the introduction. Chapter two describes the data and methodology used. Chapter three starts by describing the trend component of the Ecuadorian economy. Secondly, we use a regression model to explain the main factor determining the Ecuadorian Economic growth. Thirdly, we analyze the phenomenon of economic growth in terms by focusing in the human capital as an output factor in the aggregate production function. Finally, the chapter four gathers the main conclusions.

2. Design and approach

In this paper we initiate the analysis performing a characterization of the cycle of a set of aggregates of the Ecuadorian economy for the period 1960-2019 in order to characterize the business cycle in Ecuador. The key element in this type of analysis lies in identifying the cyclical component and trend of a time series. In order to perform this decomposition, we will apply theHodrick-Prescott filter. In the literature we find a wide range of examples of this type of analysis: among many examples, those carried out by Danthine and Girardin (1989) for Switzerland, Kydland and Prescott (1990) for the United States, Blackburn and Ravn (1992) for the United Kingdom, Englund, P., Persson, T. and Svensson, L. (1992) for Sweden, Fiorito and Kollintzas (1994) for the G-7 countries, Christodoulakis, N., Dimelis, S., Kollintzas, T. (1995) for EU countries, Bjornland (2000) for Norway, and Dolado, Sebastián and Vallés (1993), Ortega (1994), Puch and Licandro (1997), André and Pérez (2005) and Bongers, Torres and Rodríguez-López (2010) for the Spanish economy.

To determine the main factors in Ecuadorian economic growth we developed and use a multiple regression analysis.

In order to stablish the economic conditions of the country we used the following explained variables for the model:

a) GDP per capita. GDPpc as a growth rate extracted from the Maddison Project Database
b) Human Capital Index. Based on years of schooling and returns to education

For the explicative variables the following were used:

a) a) Lagged dependent variable. GDP estimation include a lagged dependent variable with an expected positive coefficient which provides consistency and "inertia" stability.
b) b) Inflation. The variation experimented by the country compilated by us from different sources.
c) c) Ecuadorian main commodity exports. Accounted as a growth rate which includes oil, banana, coffee and cacao in Free On-Board prices. Historically, these products have been a keystone in the Ecuadorian international trade representing in average 13,42% of the GDP.
d) d) The democracy index. By considering the political stability and democratic conditions, this variable is useful to us to explain the changes experimented in Ecuador between different political processes. This variable was obtained as a result of combining the autocracy and regulation of participation index in a scale from 0 to 10, being 0 the most democratic result possible. Its data were extracted from the Polity III database created by Jaggers and Gurr (2019).
e) e) The government spending in education as a part of total of total government spending.
f) f) The government investment in education as a part of GDP.

Finally, to calculate the aggregate production function of the economy, we have assumed to aggregate production functions, the first one is the Cobb-Douglas type and the second an augmented production function in which the human capital is an input.For this we have information on the human capita l index, share of labor (α-1) and capital (α) income in the total income of each economy, i.e., the technological parameters associated with the productive factor capital and labor. With all the above information, we can obtain a measure of total factor productivity (TFP) for each economy, as well as carry out the various growth accounting exercises. For this work we used a sample range from 1960-2019, separated into three periods: 1960-1972, 1973-1999 and 2000-2019. These three periods were chosen because they represent structural break points in the Ecuadorian economy, the first being an economy based on the banana boom, the second the change of the productive matrix towards an extractive-oriented economy, especially oil, and finally, the third period begins after the financial crisis and the dollarization process. As a whole, the sample is the maximum of existing data for Ecuador and will allow us to observe the main trends and changes in the long term.

As a variable representing the output, we have selected the gross domestic product (Y), while the variables representing the inputs are employment (L) and the stock of physical capital (K), to which we add the technological component of human capital (H) associated with employment, we also have the population variable (N). The level of production is represented by GDP in real terms, at constant national prices for the year 2017. The stock of physical capital is also defined in real terms, using national prices for the year 2017. Regarding the labor input, the number of workers was used because it has a wider sample range. Finally, the database incorporates a human capital index constructed from the number of years of education and returns to education, based on calculations by Barro and Lee (2013) and Caselli (2005).

The source of information that we are going to use in our analysis is the Penn World Table (PWT) database, the latest version available is version 10 and the World Bank database for Ecuador.

3. Results and discussion

3.1 Stylized facts of the Ecuadorian economy

A relatively small number of studies of this type have been carried out for the Ecuadorian case. Among them Gachet, I., Maldonado, D., Oliva, N., & Ramirez, J. (2011), Orellana, M. (2011) and Kovalenko, E. D., Pérez, M. A., & Núñez, L. B. A. (2019) who analyze this issue through the RBC methodology and stochastic dynamic general equilibrium models. In general terms, these authors obtain very similar results in terms of the characterization of the main characteristics of the Ecuadorian business cycle, behavior that is also similar to other Latin American countries. Among

the most outstanding results we find that the behavior of household consumption is highly procyclical and volatile. Government spending is also procyclical and slightly more volatile than household consumption. Additionally, investment is very volatile in relation to GDP, although highly coincidental with the level of output, and finally, the unemployment rate is countercyclical.

Figure 2 shows the Ecuadorian GDP along with a linear trend. As we can see, the level of production of the Ecuadorian economy shows an increasing trend, but with deviations from a linear trend caused by some periods in which there has been a decline in the level of production. Specifically in this figure we can observe three particularly significant moments in which the level of production is below its linear trend: in the period 1965-1972, in the period 1998-2005 and from 2016 onwards. However, this way of extracting the cyclical component would result in recession periods that are too long and would only be valid if the trend growth of the economy were truly linear and do not reflect the cyclical movements of the economy. For this reason, we will study the cyclical component of the economy using a wide variety of filtering methods.

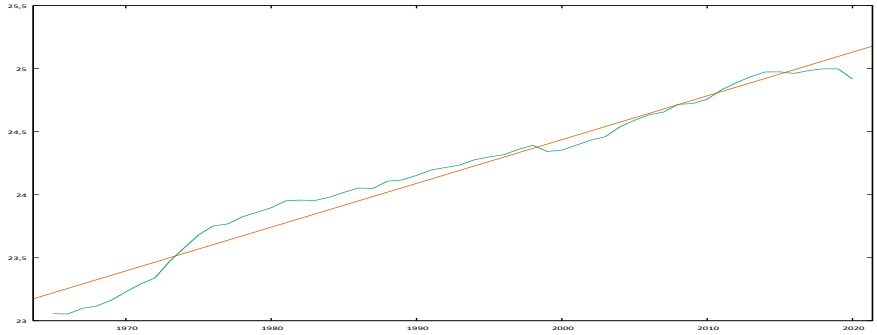

Figure 2. Ecuadorian GDP and linear trend

Figure 3 shows the year-on-year growth rate of the Ecuadorian GDP, a transformation that allows us to appreciate more easily the cyclical movements. In fact, the calculation of the year-on-year growth rate already implies the application of a filter to the time series and can be in some cases a good approximation of the cyclical component.

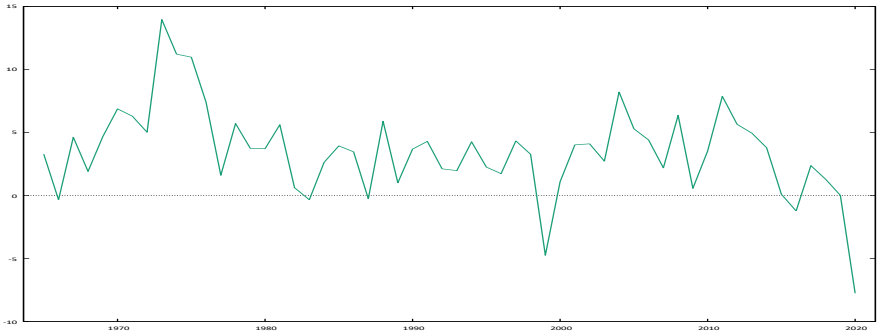

Figure 3. Interannual economic growth rate of Ecuadorian GDP

3.2 The cyclical component

To extract the cyclical component of the variables we will apply the five most common filters in cyclical component analysis for each of the macroeconomic series of the Ecuadorian economy. These filters are the most used in the literature and were developed by: Hodrick, R.J. and Prescott E.C. (1997), Baxter, M. and King, R.G. (1999), Christiano, L. and Fitzgerald, T. (2003), Beveridge, S. and Nelson C.R. (1981) and Butterworth, S. (1930). They will be represented respectively by the following acronyms: HP, BK, CF, BN and BW.

Figure 4 shows the cyclical component of GDP obtained from the different filters used. As we can see, there are important differences with respect to the cyclical component of GDP depending on the filter used, especially in the case of the Beveridge-Nelson filter. However, they all show a similar pattern of behavior in the long term, although in the short and medium term the

fluctuations are different. We note that there are filters that obtain a very similar cyclical component, for example, the CF, BK and BW filters.

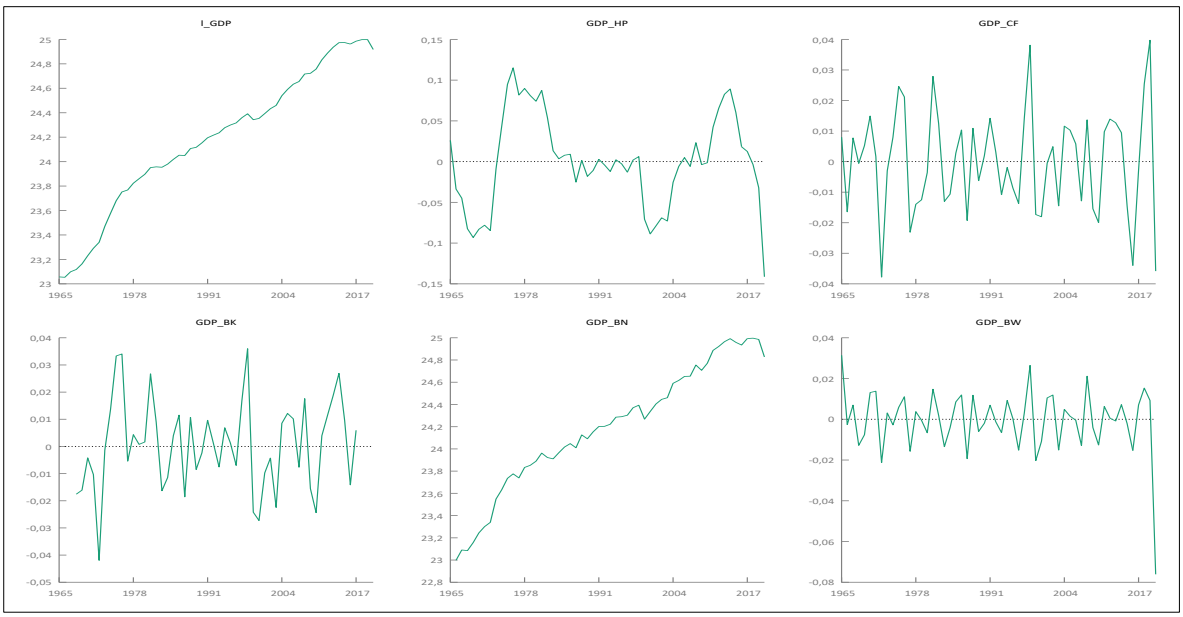

Figure 4. GDP Cyclical Component according to each decomposition filter

Table 1 shows the description of the cyclical behavior of the Ecuadorian economy, obtained from the HP filter. Using the cyclical component of GDP previously estimated, we can date the cyclical fluctuations of the Ecuadorian economy during the period 1965-2020. During this period, we observe four complete cycles, and another one that is still ongoing. We break down each of these cycles in two ways. First, we speak of cyclical stages in terms of expansion/recession, depending on whether the level of production is above or below trend, respectively. Second, we decompose the cycle into four different phases: slowdown, crisis, recovery and boom, depending on whether the difference of the cyclical component with respect to the trend is positive or negative, both in the recession phase and in the expansion phase.

The four cycles that we can identify for the Ecuadorian economy cover the periods 1965-1976, 1977-1998, 1999-2007, 2008-2014, added to the last recession period starting in 2015. As we can observe, the recession stages have been much more numerous in terms of duration than the expansion stages, however, the latter have been more pronounced.

Table 1: The Ecuadorian business cycle

Period	*cyclical stage*	*Duration (years)*	*Period*	*Cyclical Phase*	*Duration (years)*
1965-1969	Recession	5	1965	Slowdown	1
			1966-1969	Crisis	4
1970-1976	Expansion	7	1970-1973	Recovery	4
			1974-1976	Boom	2
1977-1987	Recession	11	1977-1983	Slowdown	7
			1984-1987	Crisis	4
1988-1998	Expansion	11	1988-1994	Recovery	7
			1995-1998	Boom	4
1999-2000	Recession	2	1999	Slowdown	1
			2000	Crisis	1
2001-2007	Expansion	7	2001-2005	Recovery	5
			2006-2007	Boom	2
2008-2009	Recession	2	2008	Slowdown	1
			2009	Crisis	1
2010-2014	Expansion	5	2010-2011	Recovery	2
			2012-2014	Boom	3
2015-?	Recession	?	2015-2017	Slowdown	3

3.3 Distribution of total rent among production factors

A key variable in the growth accounting exercise is the share of labor income in total income in economies. The Cobb-Douglas aggregate production function we are using considers the existence of two productive factors: capital and labor. Therefore, the total income of an economy must be distributed between remunerations to these two factors. This distribution is important because it is a weighting factor of the contributions of each of the productive factors to the growth of production, and it is also fundamental for analyzing the inequality of an economy. Figure 5 shows the evolution over time of labor income as a percentage of total income for the entire period analyzed.

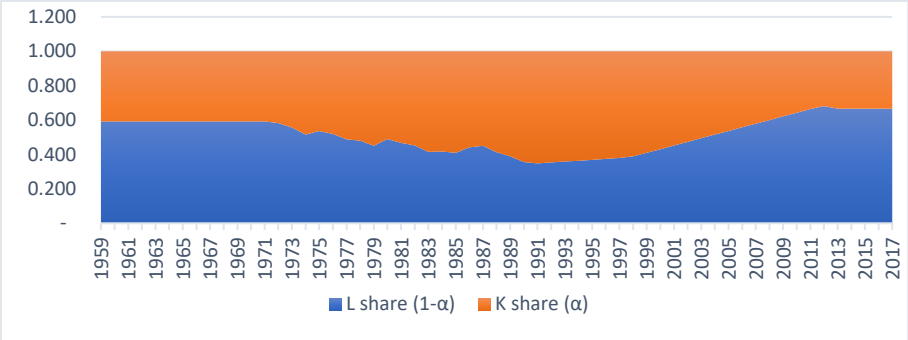

Figure 5. Labor and capital share proportion over rent total

It can be seen that the share of labor income in total income declined during the period 1973-1999 but reached levels even higher than those of the 1960s as of 2010. This means that the accumulation of physical capital has a lesser impact on the evolution of GDP, while variations in the labor factor, both in terms of quantity (employment) and quality (human capital) are of greater importance. The importance of this phenomenon in the field of economic growth is due to the assumed relationship between the share of labor income and inequality in income distribution (Piketty, 2014), because capital income tends to be accumulated in the richest part of the population, so that increases in the share of capital income would lead to an increase in inequality. However, such a relationship does not seem to be direct, given the changes in the level of complementarity between physical capital and labor, as well as the effect of the greater endowment of human capital, consequences of technological progress.

3.4 The econometric model

3.4.1 The GDP per capita growth rate

In order to quantify the importance of both external and internal factors to the Ecuadorian economy a multiple regression analysis will be performed. Based on our theoretical framework, the basic empirical specification for our econometric model is as follows:

$$Y_t = \alpha + Y_{t-1} + \sum_j^n a_i + \varepsilon_t \quad (1)$$

Wheret=1,...,T and j= control variables.

Having as the dependent variable the GDP per capita growth rate and the explanatory variables the GDP per capita growth rate lagged one period, the inflation rate, the democracy index, the international commodity pricesgrowth rate and the human capital index.We obtained the following results:

Table 2: Real GDP per capita growth rate (1960-2019)

Dependent variable: GDPpc growth rate (1960-2019)	1	2	3	4
Constant	2.808	1.772	1.791	1.766

	(4.012)	(1.732)	(1.854)	(1.694)
GDP growth -1	-0.037	-0.065	-0.093	-0.099
	(-0.268)	(-0.468)	(-0.702)	(-0.645)
Inflation	-0.041	-0.031	-0.035	-0.033
	(-1.931)	(-1.391)	(-1.659)	(-1.574)
Democracy		0.230	0.137	0.286
		(1.380)	(0.854)	(0.645)
Commodities prices			0.040	0.035
			(2.726)	(2.654)
Human Capital				0.065
				(2.125)
Adjusted R2	0.033	0.049	0.152	0.126

Note: t Statistic between ()

We can notice in table 2 that the Ecuadorian economic growth rate can be mostly explained by the changes in the international prices of its commodities, especially oil, banana, coffee and cocoa.This simple model allows us to explain the extremely volatile business cycle in Ecuador. It is also important the contribution of human capital in the economy meaning that there is a direct relation between GDP growth rates and the evolution of human capital.

3.4.2 The Human Capital Index

In order to quantify the importance of both Government Spending and Government Investment for the increase of Human Capital in Ecuador a multiple regression analysis will be performed. Based on our theoretical framework, the basic empirical specification for our econometric model is as follows:

$$Hc_t = \alpha + \sum_j^n a_i + \varepsilon_t \quad (2)$$

Where,t=1,...,T and j= control variables.

Having as the dependent variable the Human Capital Index and the explanatory variables the Government Spending growth rate in education as a part of Total Government Spending and the Government Spending growth rate in education as a part of GDP. We obtained the following results:

Table 3: Human Capital Index (1960-2019)

Dependent variable: Human Capital Index (1960-2019)	**1**	**2**	**3**	**4**
Constant	0.498	0.493	0.456	0.456
	(34.857)	(33.661)	(20.318)	(20.002)
Gov. Spendingin education	0.004	0.003	0.002	0.002
	(2.556)	(2.460)	(1.481)	(1.432)
Gov. Investment in education		0.001	0.001	0.001
		(1.941)	(1.573)	(1.446)
Democracy			0.011	0.010
			(2.101)	(1.983)
Adjusted R2	0.090	0.107	0.161	0.145

Note: t Statistic between ()

As we can see in table 3, the Ecuadorian human capital increases over time rate can be explained by the public policies applied specially government spending, this mainly means government intervention in education has a big impact on the evolution of human capital index. It is also noticeable how the democracy index is relevant as an explaining factor meaning that the political stability and public policies in the long term have a important impact in the development of human capital.

3.5 The economic growth accounting

3.5.1 Economic Growth accounting

Growth accounting is a simple statistical method to study the relative importance of the different explanatory factors of the increase over time in the level of production of an economy. There is a large empirical literature that is framed within growth accounting, and whose objective is to study the relative importance in quantitative terms of each of the explanatory factors of economic growth. Examples are the works of Mankiw, Romer and Weil (1992) and Caselli (2005) among others.

To begin the analysis, we compiled the information relevant to the growth rates experienced by the different variables. Thus, Table 1 shows the average value of the compound annual growth rates of the variables for the three periods to be analyzed. The period with by far the highest growth in production during the period analyzed was 1950-1972 with 4.89%. The average growth over the entire sample period was 4.04%. As for the evolution of physical capital, this has experienced an average growth of 3.81%, and was especially intense during the period 1950-1972, due to the strong public investment in productive infrastructure, and the investments in the nascent oil sector. The growth in the labor factor is more moderate (2.99%) and homogeneous from period to period, and is strongly linked to population growth. Finally, it is necessary to highlight the evolution of human capital. This index has experienced low annual increases, indicating little relevance for the governments in power, and consequently the lack of investment in this area.

Table 1. GDP, Population, Labor, Physical and Human Capital rate growth

Period	*Y*	*N*	*L*	*K*	*H*
1960-2019	4.04	2.37	2.99	3.81	0.89
1950-1972	4.89	2.88	2.30	5.92	0.86
1973-1999	3.85	2.48	3.28	2.72	1.09
2000-2019	3.37	1.68	3.37	2.96	0.65

Note: Percentage values
Source: Penn World Table v.10

3.5.2 The Exogenous Growth Model

Traditionally, two groups of factors of different nature have been considered as explanatory of growth in production: accumulation of productive factors and technological progress. In Ecuador, similar to other developing economies, there has been a considerable increase in the quantity of productive factors, both in the form of physical capital through an intense investment process, as well as in the labor force. To study the relative importance of each group of factors in determining the increase in production, let us assume that the aggregate production function of the economy is of the Cobb-Douglas type, and is given by:

$$Y_t = A_t K_t^{\alpha} (H_t L_t)^{1-\alpha}$$

where $\boldsymbol{Y_t}$ is the output, $\boldsymbol{K_t}$is the capital stock, $\boldsymbol{L_t}$ is labor, $\boldsymbol{H_t}$ is the level of human capital, and $\boldsymbol{A_t}$ is the aggregate productivity. This mathematical function indicates the transformation of inputs into final output and includes two variables that reflect technological progress: the human capital embodied in the labor factor and the aggregate productivity variable, which we call total factor productivity (TFP).

From the aggregate production function of the economy, we can obtain the value of total factor productivity (TFP) as a residual (Solow, 1957). TFP, which would represent technological change, can be interpreted as the general level of knowledge about the productive arts available to an economy, i.e., it would be a very broad concept of technology, including organizational and institutional factors, and would reflect the aggregate productivity level of the economy in the use of all its productive factors. In other words, it would come to represent the level of aggregate productive efficiency.

Using the Cobb-Douglas aggregate production function, we can infer that economic growth is decomposed into three factors: TFP, the contribution of the physical capital stock, and the contribution of the labor factor, including both employment and human capital. Thus, we can obtain the TFP growth rate as a residual, once the contributions to the growth of the level of production of the productive factors physical capital and labor, and of human capital, which we

consider a technological component associated with the labor factor, have been calculated. The results of this decomposition exercise are shown in Table 3.

Table 3. Decomposition of GDP growth (Cobb-Douglas)

Period	*Y*	*aK*	*(1- a) L*	*(1- a) H*	*TFP*
1960-2019	4.04	1.66	1.53	0.45	0.40
1950-1972	4.89	2.41	1.36	0.50	0.60
1973-1999	3.85	1.45	1.40	0.47	0.53
2000-2019	3.37	1.13	1.90	0.36	-0.02

Note: Percentage values
Source: Penn World Table v.10

We note that the contribution of the capital stock has been the most important component during the total period analyzed with a value of 1.66%, even considering that in the period 2000-2019 its relevance was behind the contribution of labor, a period in which the TFP was negative. These results indicate that in the Ecuadorian case the main explanatory factor of production growth is the accumulation of productive factors and not total factor productivity, with the accumulation of physical capital having a preponderant weight over time. The contribution of employment has also been positive in all periods, with an overall contribution of 1.53% annual average, while the contribution of human capital has been 0.45%. The other important result we obtain is that the growth rates of total factor productivity are relatively low with respect to the accumulation of productive factors.

In general, we obtain that per capita income growth has been mainly determined by the accumulation of productive factors, while total factor productivity (technological change) has had a more moderate contribution. These results are in line with those already pointed out by Bernanke and Gürkaynak (2001) and Bongers and Torres (2020) for Latin American countries, in the sense that the accumulation of inputs, mainly physical capital but also labor, has been the fundamental factor in explaining output growth in developing countries.

3.5.3 The Endogenous Growth Model

Finally, alternatively, if we consider the augmented neoclassical production function developed by Mankiw, Romer and Weil (1992) where human capital is an additional productive factor, we have the following expression:

$$Y_t = A_t K_t^{\alpha} H_t^{\beta} L_t^{1-\alpha-\beta}$$

The practical application of the previous specification requires knowing the value of the productivity parameter of human capital, which would be different from that corresponding to labor. For them we will use a value of 0.28 for the elasticity parameter of production with respect to human capital, and 0.30 for the elasticity with respect to physical capital, standard values in the literature.

Using these default values, we obtain:

Table 6. Decomposition of GDP growth adding the using the augmented production function

Period	*Y*	*aK*	*ßH*	*(1- a-ß) L*	*TFP*
1960-2019	4.04	1.14	0.25	1.26	1.39
1950-1972	4.89	1.78	0.24	0.97	1.91
1973-1999	3.85	0.82	0.30	1.38	1.36
2000-2019	3.37	0.89	0.18	1.41	0.88

Note: Percentage values
Fuente: Penn World Table v.10

Thus, Table 6 shows that by modifying the values of the elasticities and adding human capital as a factor of production, the accumulation of productive factors continues to explain a large part of economic growth. However, it is interesting to analyze the relevance that this production function

4 Conclusions

In this paper we have characterized the so-called stylized facts of the Ecuadorian business cycle the annual series from 1960 to 2019. In order to carry out the analysis, first of all, we have to decompose the time series into its trend component and its cyclical component. This component can be obtained by applying a filter to the series that allows us to separate the secular trend part in order to isolate the cyclical fluctuations. In this work we have applied the Hodrick-Prescott filtering method. Starting from the cyclical component, we have performed several analyses with the objective of determining the main characteristics of cyclical fluctuations in Ecuador. This analysis allowed us to describe that the volatility of the Ecuadorian economy is mainly caused by its dependence on the primary sector and the external commodity prices.

Secondly, we used a multiple regression model focused to quantify the importance of human capital and commodities international prices for the Ecuadorian economy, and how the first explains the cyclical movements of the economy. It is also noticeable how human capital is statistically significant in explaining the GDP per capita growth rate over time.
We also developed a simple model to explain and measure the relation between public spending and investing in education and the human capital. Finding that these two factors are relevant to explain the increase that human capital has had over time.

Finally, we used the growth decomposition method to study the determinants of economic growth in the country. The analysis carried out allows us to identify how the accumulation of productive factors and aggregate productivity in the economy has evolved as a fundamental element to explain the growth of production levels. Specifically, we have used the so-called growth accounting approach, which allows us to obtain a measure of total factor productivity, an element that has been key to explaining the growth of production. The results indicate that human capital has indeed been a key factor in the increase of the production over time.

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