Characterization of the Economic Cycle in Ecuador 1965-2020

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Abstract

A characterization of Ecuador's economic cycle is carried out in this paper, using different methods of trend-cycle decomposition for the most relevant macroeconomic aggregates of the economy. The data used has an annual frequency for the period 1965-2020, and contains the analysis of the main productive sectors, components of aggregate demand and factor market of the Ecuadorian economy. The results obtained are in full agreement with the theoretical assumptions, including the following. First, the cyclical component of both the GDP of the primary sector and the oil sector show high volatility, which causes cyclical fluctuations in Ecuador to be significant. Second, the volatility of consumption is higher than that of GDP, which is evidence of deviations from the life-cycle hypothesis. Third, public spending shows a very high relative variability, as well as a procyclical and coincident compartment with economic activity. It is therefore an automatic mechanism, whereby public spending increases when public revenues are higher and decreases when public revenues fall. Finally, employment is less volatile than economic activity, which results in a procyclical behavior of labor productivity.

Keywords: Cyclical fluctuations, lineal tendency, cyclical component, decomposition filters.

1. Introduction

The study of business cycles began with the pioneering work of Burns and Mitchell (1946). Subsequently, Lucas (1977) and Kydland and Prescott (1990) are two of the works that have had the greatest impact and have become important references. These initial studies have given rise to an extensive literature, both theoretical and empirical, focused on the study of cyclical fluctuations and 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. An economic 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 suffered ups and downs over time, with periods in which economists were very interested in the economic 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 a 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 try to reduce these fluctuations through stabilization policies.

Certainly, the study of cycles is an interesting analysis for a wide range of reasons, as well as being a key element in making economic forecasts. In the first place, it allows to obtain a measure of fluctuations over time, making it possible to know how the different variables move with respect to the cycle behavior of the level of production, as well as the degree of correlation between them. Secondly, the study of the cycle makes it possible to weight the degree of volatility shown by the dynamics of the different macroeconomic aggregates, in relation to the variability shown by the level of production. This analysis can be of great importance since, for example, by measuring the volatility of the cyclical component of consumption with respect to that of the level of production, one can infer the validity of the permanent life-cycle-income hypothesis. This analysis is also of great importance in terms of the study of the labor market, by determining how movements in the level of employment and labor productivity are during the different phases of the economic cycle. Thirdly, because of its interest for economic forecasting, the analysis of the cycle makes it possible to identify leading indicators. In this sense, one of the main challenges of economic forecasting is to anticipate changes in the phases of the

cycle. These leading indicators can be very useful for detecting changes in the behavior of the economy in the short term.

The structure of this paper is as follows. The second section describes the sources used to collect data, as well as the methodology used. The third section describes and applies the different methods used to obtain the trend component to a set of series of the Ecuadorian economy, in order to analyze the relationship between the cyclical component of the different sectors and the Ecuadorian economy as a whole through the study of their volatility, correlations and comovements. Finally, the fourth section presents the most relevant conclusions that can be drawn from the results obtained.

2. Design and approach

This paper characterizes the cycle of a set of aggregates of the Ecuadorian economy for the period 1965-2020 in order to characterize the economic cycle in Ecuador. The key element in this type of analysis lies in identifying the cyclical component and trend of a time series. A variety of filters will be applied to a small but sufficiently representative set of macroeconomic variables to decompose the selected series. The cycle of the different series will be studied in relation to the cyclical behavior of GDP. The ultimate objective is to offer a set of facts about the short- and medium-term behavior of the Ecuadorian economy.

The literature provides a large body 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 et al. (1992) for Sweden, Fiorito and Kollintzas (1994) for the G-7 countries, Christodoulakis et al. (1995) for EU countries, Bjornland (2000) for Norway, and Dolado et al. (1993), Ortega (1994), Puch and Licandro (1997), André and Pérez (2005) and Bongers et al. (2010) for the Spanish economy.

The analysis to be carried out uses different statistical procedures for the study of the cyclical behavior of the Ecuadorian economy. A battery of decomposition filters is applied to extract the cyclical component of each variable, which will allow characterizing the economic cycle in Ecuador. These cyclical components are used to study the volatility and comovements of the different variables.

The series to be used are the main series of an economy, distributed as follows: GDP by productive sector, aggregate demand components, and productive factors market. For reasons of data availability and extension of the series, the series are annual, and the sample period used is from 1965 to 2020 and come from the Central Bank of Ecuador's database, complemented with the PWT v. 10 database and the World Bank's database.

3. Results

3.1 Stilyzed facts of the Ecuadorian economy 1965-2020

A relatively small number of studies of this type have been carried out for the Ecuadorian case. Among them Gachet et al. (2011), Orellana (2011) and Kovalenko et al. (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 economic cycle, behavior that is also similar to that of other Latin American countries. Among the most outstanding results is that household consumption behavior is highly procyclical and volatile. Government spending is also procyclical and slightly more volatile than household consumption. In addition, investment is very volatile in relation to GDP, although highly coincident with the level of output, and finally, the unemployment rate is countercyclical.

The purpose of this paper will be to deepen the analysis carried out by the previous authors in order to contrast and extend the results. For this purpose, the series in this study are the main series of an economy: GDP, sectoral GDP, oil and non-oil GDP, Consumption, Investment, Public Expenditure, External Sector, Economically Active Population, Employed Population, Unemployed Population, Labor Productivity and Capital Productivity.

Figure 1 shows the series used in the analysis. As can be noted, all macroeconomic series show a growth over time, except for the unemployed population. This secular component can be represented by a positive trend, except in the case of unemployment, which shows a negative trend during the period analyzed. However, this growth is not sustained, and there are significant deviations from a linear trend, which can be clearly observed in variables such as investment or capital productivity, in addition to those corresponding to sectoral GDP. These deviations are precisely representing the cyclical fluctuations through which the economy is going through. In order to study its cyclical behavior, it is first necessary to extract this component from the series, separating it from the trend component.

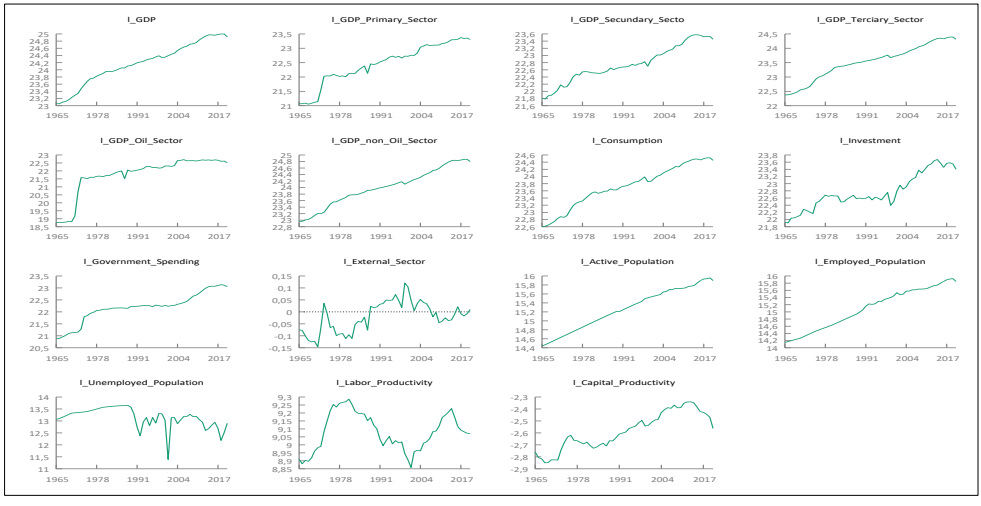

Figure 1. Original Series (logarithmic values)

Figure 2 shows Ecuador's GDP along with a linear trend. 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, this figure clearly shows 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, the cyclical component of the economy will be studied using a wide variety of filtering methods.

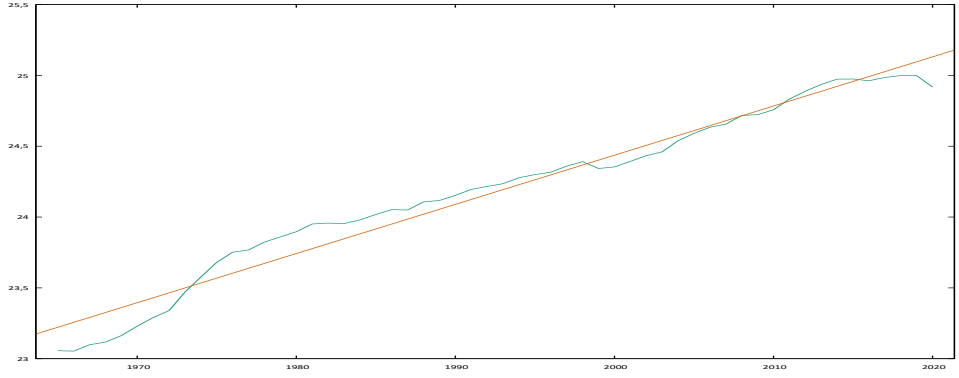

Figure 2. Ecuadorian GDP and linear trend

Figure 3 shows the year-on-year growth rate of Ecuador's GDP, a transformation that allows to easily appreciate the cyclical movements in the national GDP. 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.

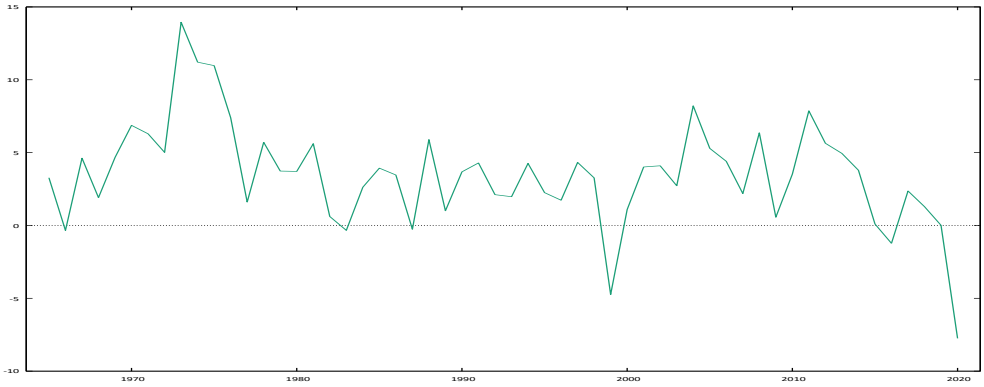

Figure 3. Interannual economic growth rate of Ecuadorian GDP

3.2 The cyclical component

The five most common filters in cyclical component analysis will be applied to each of the macroeconomic series of the Ecuadorian economy in order to extract the cyclical component of the variables. These filters are the most commonly used in the literature and were developed by: Hodrick and Prescott (1997), Baxter and King (1999), Christiano and Fitzgerald (2003), Beveridge and Nelson (1981) and Butterworth (1930) and are 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. There are important differences in 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 medium term, although the shorter-term fluctuations are different. There are filters that obtain a very similar cyclical component, for example, the CF, BK and BW filters.

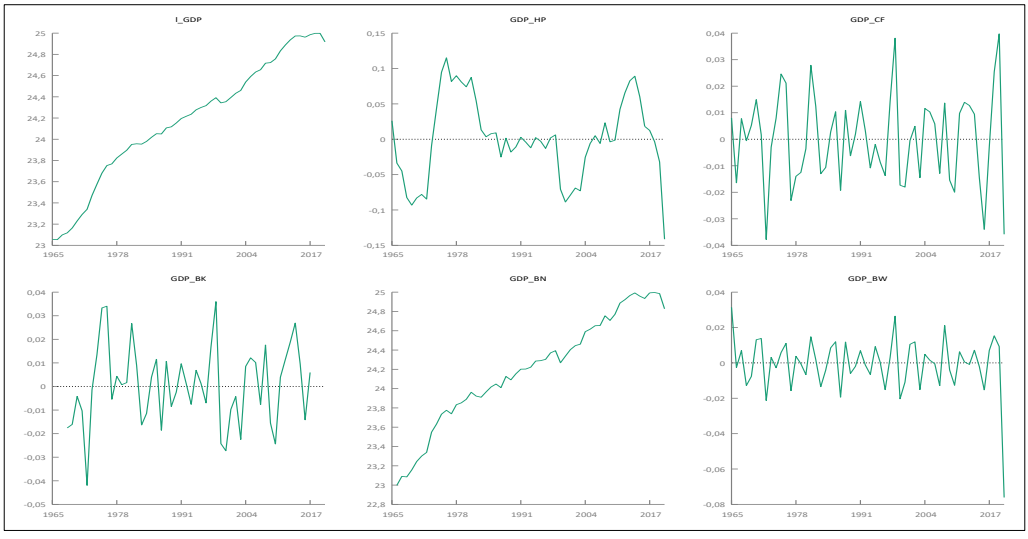

Figure 4. GDP Cyclical Component according to each decomposition filter

Figure 5 shows the cyclical component of the variables according to the results provided by the HP filter with □ = 1,600, which is the most commonly used in similar works. This figure allows to clearly appreciate the cyclical behavior of the different series analyzed.

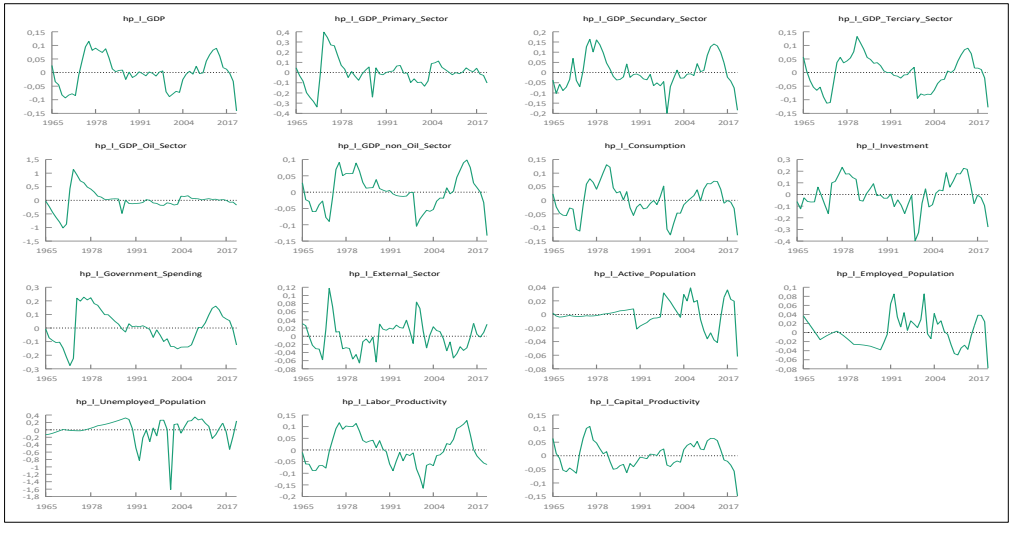

Figure 5. Cyclical Component of the variables using the HP filter

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, it is possible to date the cyclical fluctuations of the Ecuadorian economy during the period 1965-2020. During this period, four complete cycles are observed, and another one that is still in force. Each of these cycles is broken down in two ways. First, the cyclical stages are described in terms of expansion/recession, depending on whether the level of production is above or below trend, respectively. Second, the cycle is broken down 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.

Table 1: The Ecuadorian business cycle

Period	Cyclical stage	Duration (years)	Period	Cyclical Phase	Duration (years)
1965-1969	Recesion	5	1965	Ralentization	1
			1966-1969	Crisis	4
1970-1976	Expantion	7	1970-1973	Recuperation	4
			1974-1976	Boom	2
1977-1987	Recesion	11	1977-1983	Ralentization	7
			1984-1987	Crisis	4
1988-1998	Expantion	11	1988-1994	Recuperation	7
			1995-1998	Boom	4
1999-2000	Recesion	2	1999	Ralentization	1
			2000	Crisis	1
2001-2007	Expantion	7	2001-2005	Recuperation	5
			2006-2007	Boom	2
2008-2009	Recesion	2	2008	Ralentization	1
			2009	Crisis	1
2010-2014	Expantion	5	2010-2011	Recuperation	2
			2012-2014	Boom	3
2015-?	Recesion	?	2015-2017	Ralentization	3
			2018-?	Crisis	?

The four cycles that can be identified for the Ecuadorian economy cover the periods 1965-1976, 1977-1998, 1999-2007, 2008-2014, plus the last period of recession that began in 2015. As can be seen, the recessionary stages have been much more numerous in terms of duration than the expansionary stages, however, the latter have been more pronounced.

3.3 Volatility

One of the most important characteristics of this type of analysis is that we can know the magnitude of the fluctuations experienced by the different variables throughout the cycle. Thus, we will have some variables that show low variability, i.e., that do not experience large cyclical variations, while other variables will experience large variability, with respect to their long-term trend.

Table 2 shows the standard deviation of the cyclical component of each variable as a function of the decomposition method used. Although the resulting volatility for each variable depends on the filter used, in general, a number of well-defined patterns can be found. First, the volatility of the level of activity in the different productive sectors is very different. Thus, there is high volatility in the cyclical component of GDP in the primary sector and the oil sector are very high as a result of the variation of Ecuadorian commodity prices and their influence on overall

economic activity, likewise, investment, government spending and the unemployed population experience high volatilities. On the contrary, volatility is lower in the case of the level of activity in the secondary and tertiary sectors, which are the most stable.

Table 2: Standard deviation of the cyclical component

	HP	BK	BN	CF	BW
GDP	0.0343	0.0167	0.5602	0.0169	0.0154
GDP Primary Sector	0.1082	0.0691	0.6729	0.0605	0.0491
GDP Secundary Sector	0.0475	0.0340	0.4961	0.0319	0.0287
GDP Terciary Sector	0.0333	0.0188	0.5864	0.0207	0.0171
GDP Oil Sector	0.2739	0.1712	1.1270	0.1548	0.1106
GDP non-Oil Sector	0.0315	0.0201	0.5509	0.0209	0.0172
Consumption	0.0382	0.0276	0.5565	0.0289	0.0229
Investment	0.0844	0.0715	0.4812	0.0684	0.0661
Government Spending	0.0749	0.0459	0.5818	0.0437	0.0411
External Sector	0.0297	0.0242	0.0625	0.0226	0.0196
Active Population	0.0162	0.0084	0.4486	0.0091	0.0064
Employed Population	0.0242	0.0162	0.5534	0.0166	0.0146
Unemployed Population	0.2790	0.2480	0.4181	0.2397	0.2341
Labor Productivity	0.0356	0.0215	0.1167	0.0189	0.0159
Capital Productivity	0.0309	0.0161	0.1526	0.0161	0.0143

Table 3 shows the relative variability of each cyclical component with respect to the GDP cycle. A value greater than unity would indicate that the cyclical component of the series in question is more volatile than that corresponding to the economy's aggregate level of output, while a value less than unity would indicate a smoother cyclical profile of the variable.

Table 3: Relative variability regarding the cyclical component of the GDP

	HP	BK	BN	CF	BW
GDP	1.00	1.00	1.00	1.00	1.00
GDP Primary Sector	3.15	4.14	1.20	3.58	3.19
GDP Secondary Sector	1.38	2.04	0.89	1.89	1.86
GDP Tertiary Sector	0.97	1.13	1.05	1.22	1.11
GDP Oil Sector	7.99	10.2	2.01	9.16	7.18
GDP non-Oil Sector	0.92	1.20	0.98	1.24	1.12
Consumption	1.11	1.65	0.99	1.71	1.49
Investment	2.46	4.28	0.86	4.05	4.29
Government Spending	2.18	2.75	1.04	2.59	2.67
External Sector	0.87	1.45	0.11	1.34	1.27
Active Population	0.47	0.50	0.80	0.54	0.42
Employed Population	0.71	0.97	0.99	0.98	0.95
Unemployed Population	8.13	14.8	0.75	14.1	15.2
Labor Productivity	1.04	1.29	0.21	1.12	1.03
Capital Productivity	0.90	0.96	0.27	0.95	0.93

With respect to the productive sectors, those with the lowest cyclical volatility with respect to the aggregate level of activity are the tertiary and non-oil sectors, while the primary and secondary sectors show high volatility. There is also a very high volatility in the oil sector, as a result of the fluctuating prices of this commodity, which are exogenous to the economy. On the other hand, it could be established that the productive sectors with greater cyclical stability are

the services sector and the non-oil economy as a whole, which have a lower level of intensity in cyclical fluctuations in relation to the aggregate productivity level of the economy. In this sense, it should be taken into account that the primary sector, especially the agricultural activity, as well as mining and oil extraction have a high relative importance in the Ecuadorian economy, being factors of volatility in the aggregate production level of the economy.

In general terms, consumption shows a higher relative volatility with respect to the level of production, although this is low. The relative variability of consumption is greater than unity, except in the BN filter, indicating deviations from life cycle theory. This result has important consequences with respect to theoretical developments predicting that consumption should be a variable with smoother dynamics than the level of production. Indeed, the permanent life-cycle-income theory indicates that individuals can select the optimal consumption profile and separate it from their income profile. This would mean that cyclical fluctuations in consumption would have to be smaller than those recorded by the activity of the economy. While this is true in most developed economies, it is not true in the case of the Ecuadorian economy, as it is in the vast majority of developing countries. One plausible explanation is the characteristics of the financial markets, which are underdeveloped (due to the existence of liquidity restrictions, causing part of the agents not to have access to credit), and the low wages and poor quality of employment, which makes Ecuadorian consumers, mostly non-Ricardian, and therefore, their consumption level is highly conditioned by the level of their income.

As expected, investment has a very high relative volatility, since it is a highly variable component that is strongly influenced by expectations. This means that the cyclical fluctuations of investment are very high in relation to those of GDP, which is a component of aggregate demand that is sensitive to the economic situation. Public spending also shows a high relative variability much higher than unity. This means that public spending in Ecuador shows a higher variability than GDP. This circumstance is explained by the increases in spending in times of greater economic activity, as a result of the increase in tax revenues and in times of oil bonanza, since the state is largely the owner of oil revenues.

The external balance is less volatile than aggregate activity. This means that the volume of exports is not very sensitive to movements in the level of activity. However, the empirical evidence indicates that imports do increase in times of higher activity; this condition seems to indicate that, in the face of a variation in the level of income, most of this variation is transformed into imports. With respect to the variables associated with the factors of production, the active population is more stable than the level of activity, but the opposite occurs with the level of unemployment. Thus, it turns out that unemployment in Ecuador is a more volatile variable than the level of activity. This result also explains why labor productivity is more volatile with respect to the level of production.

3.4 Comovements

Next, cross-correlations between the different cyclical components and the one corresponding to the level of production will be calculated. In this way, a characterization of the cyclical behavior of the different macroeconomic variables analyzed can be obtained. The comovements between

the different variables selected with GDP are obtained by calculating the correlations between their cyclical components. From these correlations, the comovements can be characterized, which allows the variables to be classified as procyclical, countercyclical or acyclical. On the other hand, correlations are calculated for different moments in time, through the calculation of the so-called cross-correlation function. This allows obtaining a measure of the synchrony between the different cyclical components.

3.4.1 Productive sectors

First, the comovements of the production levels of each of the five productive sectors (primary, secondary, tertiary, oil and non-oil) into which the economy is divided with respect to aggregate production will be calculated.

GDP Primary Sector: The production level of the primary sector, composed mainly in Ecuador by agriculture, fishing and exploitation of minerals and hydrocarbons, contributes 20% of the national GDP, and has a relatively high correlation with respect to the aggregate production level of the economy. Thus, the correlation coefficients are all positive except for the CF filter and range from 0.98 with the BN filter to 0.22 with the CF and BW filters.

This result indicates that the activity of the primary sector is affected to some extent by the general level of activity of the economy. This is possibly due to the fact that the volume of investment in this sector is very important in the case of Ecuador, mainly in the oil and mining sector, and that this investment is affected by the general behavior of the economy, which could explain the high correlation between the cyclical fluctuations of the primary sector and general activity. Based on the results obtained, GDP in the primary sector is procyclical and coincides with the aggregate GDP of the economy.

Table 4. Cross Correlations: GDP vs GDP Primary Sector

	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4
HP	-0.46	-0.25	-0.05	0.17	0.55	0.54	0.47	0.23	-0.02
CF	0.04	0.11	-0.19	-0.36	0.22	0.22	0.24	-0.01	-0.31
BK	-0.15	-0.10	-0.07	-0.18	0.33	0.31	0.30	0.12	-0.21
BN	0.69	0.77	0.85	0.92	0.98	0.93	0.87	0.81	0.74
BW	-0.01	0.24	-0.01	-0.31	0.22	-0.05	0.06	0.00	-0.04

GDP Secondary Sector: The cyclical component of GDP in the secondary sector responds mainly to manufacturing industries and construction and contributes with 23% of Ecuador's GDP. As can be seen, both are closely related to the general level of activity in the economy. The correlation coefficients range from 0.98 in the case of the BN filter to 0.42 for the CF and BK filters. On the other hand, the maximum correlation for all filters is obtained in the period at the same moment in time, being coincident with the behavior of aggregate activity. Therefore, it is possible to conclude that the GDP of the secondary sector is a procyclical variable and coincident with the level of aggregate activity of the economy.

Table 5. Cross Correlations: GDP vs GDP Secondary Sector

	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4
HP	-0.07	-0.01	0.13	0.28	0.58	0.33	0.23	0.19	0.10
CF	0.06	-0.10	-0.12	0.03	0.42	-0.20	-0.32	-0.04	0.25
BK	0.04	-0.07	-0.10	0.11	0.42	0.00	-0.15	0.01	0.23

BN	0.74	0.80	0.87	0.93	0.98	0.93	0.86	0.80	0.73
BW	0.10	-0.07	-0.14	-0.07	0.55	-0.15	-0.20	0.05	0.14

PIB Tertiary Sector: The services sector is the sector with the greatest weight in the economy as a whole, with 55%, so we should expect its behavior throughout the cycle to be similar to that of the economy as a whole. In effect, these are the results obtained.

The results yielded by the different filters are very similar, presenting a high correlation with the cyclical component of the economy's aggregate GDP, with values ranging from 0.76 to 1.00. Therefore, service sector GDP is procyclical and coincident with the aggregate activity of the economy.

Table 6. Cross Correlations: GDP vs GDP Tertiary Sector

	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4
HP	0.10	0.22	0.37	0.57	0.82	0.33	-0.05	-0.22	-0.28
CF	-0.24	-0.39	-0.27	0.22	0.81	0.05	-0.52	-0.36	0.06
BK	-0.13	-0.11	-0.05	0.33	0.76	0.14	-0.39	-0.23	-0.02
BN	0.76	0.82	0.88	0.94	1.00	0.94	0.87	0.80	0.74
BW	0.09	-0.04	-0.26	-0.07	0.85	-0.06	-0.37	-0.03	0.24

GDP Oil Sector: The oil sector is especially relevant in the case of the Ecuadorian economy, representing approximately 11% of GDP during the entire period analyzed. The results in this case yield quite different values depending on the filter applied, ranging from -0.06 in the CF filter to 0.88 in the BN filter. For the purposes of this paper, the results obtained by the HP filter are considered valid, therefore, the GDP of the oil sector is procyclical and is two periods ahead of the aggregate activity of the economy.

Table 7. Cross Correlations: GDP vs GDP Oil Sector

	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4
HP	-0.41	-0.25	-0.08	0.11	0.44	0.53	0.54	0.32	0.23
CF	0.16	0.16	-0.12	-0.43	-0.06	0.22	0.40	0.16	-0.27
BK	-0.10	0.09	-0.01	-0.23	0.11	0.32	0.43	0.23	-0.15
BN	0.47	0.58	0.69	0.79	0.88	0.85	0.81	0.76	0.70
BW	-0.01	0.22	0.11	-0.30	-0.04	-0.03	0.14	0.07	-0.10

GDP non-Oil Sector: The non-oil sector includes the economic activity outside the exploration, exploitation and export of oil in Ecuador, accounting for about 84% of GDP. The results in this case show similar values depending on the filter applied, ranging from 0.70 in the BK filter to 1.00 in the BN filter, indicating that when the economy is detached from the oil sector, it gains stability. The GDP of the non-oil sector is procyclical and is coincident with the aggregate activity of the economy.

Table 8. Cross Correlations: GDP vs GDP non-Oil Sector

	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4
HP	-0.04	0.08	0.29	0.54	0.84	0.39	0.07	-0.07	-0.13
CF	-0.19	-0.34	-0.23	0.23	0.73	-0.06	-0.52	-0.28	0.15
BK	-0.13	-0.16	-0.09	0.34	0.70	0.08	-0.35	-0.15	0.09
BN	0.76	0.83	0.89	0.95	1.00	0.94	0.87	0.80	0.73
BW	0.08	-0.08	-0.24	-0.02	0.78	-0.12	-0.35	0.00	0.23

3.4.2 Aggregate demand components

Next, the cyclical behavior of the components of aggregate demand, namely consumption, investment, public spending and the external sector balance, will be described.

Consumption: Consumption is the main component of an economy's GDP. According to the data used, consumption accounts for around 63% of the Ecuadorian economy's GDP. This quantitative importance makes its cyclical characterization very important. All filters indicate that consumption is a procyclical variable, having the highest correlation at the present time.

The results range from a correlation of 0.67 in the BK filter to 1.00 in the BN filter. The results obtained for the Ecuadorian economy are similar to those of other developing economies, with consumption being a highly procyclical and synchronized variable with respect to fluctuations in the economy's production level.

Table 9. Cross Correlations: GDP vs GDP Consumption

	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4
HP	0.08	0.12	0.24	0.49	0.73	0.29	-0.05	-0.15	-0.16
CF	-0.16	-0.40	-0.32	0.24	0.74	0.05	-0.49	-0.30	0.11
BK	-0.06	-0.21	-0.19	0.29	0.67	0.08	-0.40	-0.15	0.10
BN	0.75	0.81	0.88	0.94	1.00	0.94	0.88	0.81	0.75
BW	0.12	-0.09	-0.28	0.03	0.73	-0.08	-0.38	0.00	0.30

Investment: Investment is a very important component of an economy's aggregate demand, not in quantitative terms like consumption, but in qualitative terms. Investment determines the process of capital accumulation and, therefore, is conditioning its future growth possibilities. In the Ecuadorian economy, according to the data used, it represents around 25% of GDP during the period analyzed. Investment is a highly volatile component, presenting a high variability over time since it is fundamentally tied to the population's expectations.

The corresponding cross-correlation matrix presents similar results according to all the filters used, given this particular dynamics of investment, the results range from 0.45 with the HP filter to 0.93 with the BN filter. Investment, then, would be a procyclical variable with the general level of activity of the economy and with synchronized cyclical phases.

Table 10. Cross Correlations: GDP vs GDP Investment

	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4
HP	0.08	0.05	0.08	0.19	0.45	0.14	0.02	0.14	0.16
CF	0.14	-0.14	-0.24	0.02	0.50	-0.15	-0.39	0.04	0.29
BK	0.14	-0.09	-0.20	0.07	0.46	-0.10	-0.29	0.17	0.21
BN	0.71	0.76	0.82	0.87	0.93	0.87	0.81	0.74	0.67
BW	0.20	-0.04	-0.21	-0.07	0.64	-0.12	-0.35	0.11	0.26

Government spending: Public spending is a component of aggregate demand that is determined by the country's public policies. In the period analyzed, it has represented an average value of around 14% of GDP, although its weight has varied gradually over time depending on the political vision of the government in power. The analysis of the cyclical behavior of public spending is of great importance since it will indicate both the type of fiscal policy carried out according to the cyclical behavior of the economy and the importance of the shocks derived from this policy. If fiscal policy is used as a stabilization policy, it is expected to be countercyclical. That is, public spending would tend to decrease in expansionary phases, while it would increase

in recessionary phases. However, if fiscal policy acts as an automatic mechanism, the opposite behavior should be expected, i.e., increases in public spending in expansionary phases and decreases in public spending in recessionary phases, in line with the behavior of public revenues derived from taxes.

The correlation matrix for the cyclical component of public spending shows that public spending is a procyclical variable in all cases, with very high correlation coefficients in most cases. In general terms, the results seem to indicate that public spending in Ecuador is a procyclical variable and synchronized with the level of economic activity. This would indicate that fiscal policy on the expenditure side is not stabilizing the economy, but is merely an automatic mechanism, whereby public spending increases when public revenues are higher and decreases when public revenues fall.

Table 11. Cross Correlations: GDP vs GDP Government Spending

	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4
HP	0.03	0.21	0.36	0.59	0.72	0.47	0.16	-0.11	-0.18
CF	-0.01	-0.20	-0.29	0.19	0.44	0.17	-0.24	-0.45	-0.07
BK	0.08	0.03	-0.09	0.30	0.41	0.24	-0.09	-0.33	-0.06
BN	0.68	0.76	0.83	0.90	0.97	0.90	0.83	0.76	0.68
BW	0.18	-0.02	-0.30	0.04	0.42	0.07	-0.09	-0.22	0.13

External sector: The last component of aggregate demand is the external sector, measured through net exports, that is, exports minus imports. This external balance has been historically negative and has experienced an increasing trend for the Ecuadorian economy, although offset by oil exports, indicating that the rate of increase of imports has been higher than that of non-oil exports. We find different results depending on the filter used. If CF, BK and BW filters are considered, the correlation is negative, although the Hp filter, which indicates that the external balance (in absolute value) is procyclical, will be used as a reference for the purposes of this paper. This means that the higher the level of production, the higher the level of imports that increase the non-oil trade deficit. Thus, the trade deficit increases in expansionary periods and decreases in recessionary periods.

Regarding synchrony, the results present a great disparity. According to the HP filter, the external balance would be a forward looking variable for two periods, according to the BN and BW filters it would be coincident and according to the BK and BN filters it would be a forward looking variable for 4 periods. Based on these results we can state that the external balance is a procyclical variable and that it is two periods ahead with respect to the level of aggregate production.

Table 12. Cross Correlations: GDP vs GDP External Sector

	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4
HP	-0.36	-0.20	-0.10	-0.07	0.04	0.22	0.32	0.12	-0.11
CF	-0.03	0.24	0.14	-0.26	-0.28	0.09	0.42	0.08	-0.37
BK	-0.14	0.16	0.13	-0.20	-0.16	0.16	0.39	0.02	-0.29
BN	0.38	0.43	0.49	0.52	0.55	0.53	0.51	0.49	0.47
BW	-0.16	0.16	0.19	-0.14	-0.35	0.00	0.33	0.00	-0.33

3.4.3 Factors Market

The third and last block of variables analyzed corresponds to factor markets, basically the labor market. In this case, the cyclical behavior of the labor force, employment, unemployment and labor productivity will be analyzed. In addition, a variable whose analysis may also be of interest is the productivity of capital. Next, the comovements of this set of variables are analyzed.

Active Population: In principle, the labor force should be a procyclical variable. A higher level of activity in the economy leads to improvements in access to employment, which would encourage a larger part of the working-age population to enter the labor market. These theoretical assumptions are corroborated by the results obtained. The highest values correspond to the BN filter, with a correlation coefficient of 0.99, while the Hp, CF, Bk and BW filters show lower coefficients. On the other hand, the HP filter indicates that this variable lags 4 periods behind the behavior of the level of activity, in what seems to indicate that the population that joins the labor market is guided by expectations of improvement in the economy. Therefore, it can be concluded that the labor force is a slightly procyclical variable and lagged 4 periods behind the cycle of the level of production.

Table 13. Cross Correlations: GDP vs GDP Active Population

	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4
HP	0.16	0.15	0.11	0.04	0.11	-0.29	-0.30	-0.34	-0.25
CF	0.21	-0.08	-0.22	-0.15	0.34	-0.13	0.13	-0.02	-0.13
BK	0.18	0.20	0.11	0.05	0.06	-0.28	-0.09	-0.11	-0.08
BN	0.78	0.83	0.89	0.94	0.99	0.93	0.86	0.80	0.73
BW	0.23	-0.04	-0.13	-0.02	0.47	-0.35	0.25	0.00	-0.15

Employed population: Employment is another example of a procyclical variable, increasing in expansion stages and decreasing in recession stages, in line with the level of economic activity, which is precisely the opposite result obtained for the Ecuadorian economy. All filters give positive results. The filters present positive correlations indicating that employment is a procyclical variable and point to employment being synchronized with fluctuations in economic activity.

This result will also have implications in terms of labor productivity, since the cyclical evolution of labor productivity depends on the relative variability of the cyclical component of employment in relation to that of production. As mentioned above, the variability of employment in the economy is lower than the variability of the level of production, which means that employment is not destroyed until there is a recession or employment is not created until there is a recovery. In other words, in the Ecuadorian economy, employment begins to be created or destroyed at the same time as the evolution of production.

Table 14. Cross Correlations: GDP vs GDP Employed Population

	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4
HP	0.02	0.12	0.05	0.09	0.30	0.01	-0.09	-0.10	-0.08
CF	0.13	0.11	-0.24	-0.16	0.36	0.05	-0.12	-0.11	-0.12
BK	0.05	0.28	-0.09	-0.10	0.15	0.03	-0.10	-0.01	-0.06
BN	0.78	0.84	0.89	0.94	0.98	0.92	0.86	0.79	0.73
BW	0.08	0.18	-0.18	-0.13	0.44	-0.03	-0.07	0.04	-0.05

Unemployement population: In most economies, unemployment is a countercyclical variable, decreasing in expansionary phases and increasing in recessionary phases. Given the results obtained above for the labor force and employment, it is to be expected that also for the Ecuadorian economy unemployment is a countercyclical variable. The cross-correlations show how all filters give rise to negative correlation coefficients between the cyclical component of unemployment and that corresponding to aggregate production. Regarding synchrony, only the BK and BN filters seem to indicate that unemployment is a lagged variable, while the other CF and BW filters suggest that it is synchronized with the level of activity. Taking the results of the Hp filter as a reference, the unemployed population is a slightly countercyclical and leading variable with 4 periods.

Table 15. Cross Correlations: GDP vs GDP Unemployed Population

	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4
HP	-0.06	-0.10	0.11	0.07	-0.10	-0.07	0.06	-0.10	-0.11
CF	-0.06	-0.22	0.22	0.11	-0.22	-0.15	0.28	0.06	-0.04
BK	-0.01	-0.25	0.22	0.18	-0.10	-0.14	0.14	-0.06	-0.03
BN	-0.51	-0.52	-0.50	-0.49	-0.48	-0.45	-0.40	-0.33	-0.29
BW	-0.03	-0.24	0.23	0.13	-0.37	-0.18	0.29	-0.04	-0.06

Labor productivity: In most economies, labor productivity is a procyclical variable. This is because, although employment is a procyclical variable, as mentioned above, it has less variability than the aggregate level of production of the economy, so that in expansion phases employment increases less than the level of production, resulting in an increase in labor productivity. Using all the filters, the correlation is positive, i.e., labor productivity in Ecuador is a procyclical variable, increasing in expansionary phases and decreasing in recessionary phases. In addition, the labor productivity is coincident with the level of production.

These results indicate that, in expansionary phases, employment increases, but it does so in a smaller proportion than the level of production, evidencing the existence of technological factors that increase labor productivity, with the opposite occurring in recessionary phases. This is due to the fact that the variability of employment is lower than the variability of production. Thus, in expansion phases, employment increases less than the level of production, resulting in an increase in labor productivity, evidencing the existence of positive technological factors. On the contrary, in recessionary phases, the destruction of employment is lower than the decrease in activity levels, resulting in a decrease in labor productivity.

Table 16. Cross Correlations: GDP vs GDP Labor Productivity

	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4
HP	-0.18	-0.05	0.23	0.49	0.76	0.55	0.33	0.09	-0.11
CF	-0.20	-0.38	-0.15	0.17	0.57	-0.02	-0.26	-0.19	0.03
BK	-0.13	-0.27	-0.05	0.26	0.67	0.17	-0.04	-0.05	-0.05
BN	-0.15	-0.07	0.01	0.09	0.16	0.16	0.15	0.13	0.10
BW	0.08	-0.14	-0.11	-0.07	0.57	-0.16	-0.22	-0.01	0.20

Capital productivity: Finally, the cyclical behavior of capital productivity, calculated as the production-to-stock ratio of physical capital in the economy, is analyzed. Similar to what happens with labor productivity, in this case, capital productivity is found to be a procyclical variable. Indeed, all the filters show a high correlation between the cyclical movements of capital

productivity and the aggregate output of the economy. With respect to synchronization, the productivity of capital is coincident with the level of output.

The fact that capital productivity is procyclical is evidence that in expansion phases the increase in the capital stock is lower than the increase in the level of production, which is consistent with most theoretical models. There is also evidence of a very close short and medium-term behavior between production and the process of capital accumulation, a relationship that is made possible by the high volatility of investment.

Table 17. Cross Correlations: GDP vs GDP Capital Productivity

	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4
HP	-0.32	-0.13	0.14	0.48	0.95	0.60	0.34	0.12	-0.06
CF	-0.09	-0.29	-0.41	0.00	0.98	0.09	-0.39	-0.37	-0.12
BK	-0.15	-0.10	-0.23	0.14	0.96	0.29	-0.13	-0.09	-0.09
BN	0.69	0.76	0.82	0.88	0.93	0.91	0.87	0.83	0.77
BW	0.15	0.05	-0.30	-0.23	0.98	-0.14	-0.28	-0.02	0.15

3.5 Characterization of the variables

Once the above analyses have been carried out, the cyclical classification of the variables is made in terms of three characteristics: comovement, synchrony and volatility. The summary of the results obtained is shown in Table 18.

Table 18. Variable Classification

	Comovement	Synchronization	Volatility
GDP Primary Sector	Procyclic	Coincident	Very high
GDP Secondary Sector	Procyclic	Coincident	High
GDP Tertiary Sector	Procyclic	Coincident	Low
GDP Oil Sector	Procyclic	Advanced	Very high
GDP non-Oil Sector	Procyclic	Coincident	Low
Consumption	Procyclic	Coincident	High
Investment	Procyclic	Coincident	Very high
Government Spending	Procyclic	Coincident	Very high
External Sector	Procyclic	Advanced	Low
Active Population	Procyclic	Retarded	Very Low
Employed Population	Procyclic	Coincident	Low
Unemployed Population	Countercyclic	Advanced	Very high
Labor Productivity	Procyclic	Coincident	High
Capital Productivity	Procyclic	Coincident	Low

All variables are procyclical, except for unemployment, which has a countercyclical behavior. In the case of unemployment, this behavior is as expected and corroborates the evidence observed in most countries, in which labor productivity is procyclical or in some cases acyclical.

Regarding synchrony, most of the variables are coincident with the level of activity of the economy, except for oil GDP, the external sector, the unemployed population and the active population, the first three seem to reflect an advanced behavior, and the last one a delayed one.

Finally, with respect to the relative volatility of the different variables with respect to the aggregate GDP, the primary sector GDP, the oil sector GDP, investment, government spending and the unemployed population, show a very volatile behavior, with a great variability in the short and medium term, evidencing the existence of very pronounced cyclical fluctuations for these variables.

Secondary sector GDP, consumption and labor productivity also show higher variability than aggregate activity. In the case of consumption, this result indicates the existence of deviations from the life-cycle hypothesis, reflecting the existence of rigidities in the credit and labor markets that cause consumption to vary significantly in response to changes in income. The high volatility of public spending is also notable. In this case, it seems that the elasticity of public revenue with respect to output is greater than unity, which also results in higher public spending in excess of the increase in the level of activity. Finally, the low volatility of employment causes labor productivity to be procyclical, since it increases in expansionary phases and decreases in recessionary phases. Similarly, service sector GDP, non-oil GDP, the external sector, the labor force and capital productivity show lower levels of volatility than the aggregate level of production.

4. Conclusions

This paper has characterized the so-called stylized facts of the Ecuadorian economic cycle. For this purpose, we have selected a set of variables representative of the Ecuadorian economy. Although it is advisable to analyze the economic cycle in the short and medium term, due to various limitations we have resorted to annual series from 1965 to 2020. 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. A wide range of filtering methods have been applied in this work, since the results derived from the application of these methods can be very different. Starting from the cyclical component, various analyses have been carried out in order to determine the main characteristics of cyclical fluctuations in Ecuador. Specifically, the volatility of the different variables, as well as their comovements, have been analyzed.

The main results obtained when analyzing the productive sectors show, as expected, a very high volatility in the primary and oil sectors, as a consequence of the productive structure of the economy and the country's high dependence on changes in the prices of its main export commodities, agricultural products and oil. This is due to the fact that the volume of investment in this sector is very important in the case of Ecuador, mainly in the oil and mining sector. These sectors are procyclical in relation to aggregate production and show a coincident and advanced synchronization, respectively. On the other hand, the tertiary sector is the one that shows greater stability in the long term, experiencing a low level of volatility and occupying a preponderant role in the Ecuadorian economic structure, especially in the 21st century.

Regarding the components of aggregate demand, the results clearly correspond to the characteristics of the Ecuadorian economy, among them consumption, which is highly volatile, procyclical and coincident with the level of production, contradicting the life cycle theory. This is due to the characteristics of the Ecuadorian financial markets, which are underdeveloped, and to the low wages and poor quality of employment, which makes Ecuadorian consumers, mostly non-Ricardian, and therefore, their consumption level is highly conditioned by the level of income.

Public spending shows a very high relative variability, as well as a procyclical and coincident compartment with economic activity. This means that public spending in Ecuador varies between periods of higher and lower economic activity, as a result of increased tax revenues and periods of oil bonanza, since the state is largely the owner of oil revenues. This is a clear indication that fiscal policy is not stabilizing the economy, but rather is an automatic mechanism whereby public spending increases when public revenues are higher and decreases when public revenues fall.

The external balance is less volatile than aggregate activity, as well as procyclical and ahead of GDP. This means that the volume of exports is not very sensitive to movements in the level of activity. However, empirical evidence indicates that imports do increase in times of higher activity, this condition seems to indicate that, in the face of a variation in the level of income, most of this variation is transformed into imports. This external balance has historically been negative and has experienced an increasing trend for the Ecuadorian economy, although compensated by oil exports, indicating that the rate of increase of imports has been higher than that of non-oil exports.

With respect to the variables associated with productive factors, the labor force is more stable than the level of activity, and is also procyclical and lagged. This seems to indicate that the population entering the labor market is guided by expectations of improvement in the economy. On the employment side, employment shows a lower variability in the economy than the level of production, which means that employment is not destroyed until there is a recession or employment is not created until there is a recovery. In other words, in the Ecuadorian economy, employment begins to be created or destroyed at the same time as the evolution of production. This is confirmed by the fact that it has a procyclical movement and a synchronization coinciding with GDP. Finally, in accordance with the theoretical postulates, unemployment in Ecuador is a variable with a very high volatility, countercyclical and ahead of the level of production. This result explains why labor productivity shows a higher volatility with respect to the level of production.

Regarding labor productivity, the results indicate that it has a very high volatility, procyclical and coincident with GDP, which indicates that, in expansionary phases, employment increases, but does so at a lower rate than the level of production, evidencing the existence of technological factors that increase labor productivity, while the opposite occurs in recessionary phases. This is due to the fact that the variability of employment is lower than the variability of production. Thus, in expansion phases, employment increases less than the level of production, resulting in an increase in labor productivity, evidencing the existence of positive technological factors. On

the contrary, in recessionary phases, the destruction of employment is less than the decrease in activity levels, resulting in a decrease in labor productivity.

Finally, the fact that capital productivity is procyclical is evidence that in expansion phases the increase in the capital stock is lower than the increase in the level of production, which is consistent with most theoretical models. There is also evidence of a very close behavior in the short and medium term between production and the process of capital accumulation, a relationship that is made possible by the high volatility of investment.

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