ISSN: 2096-3246
Volume 54, Issue 03, May, 2022

Aggregate GDP and the economy sectors in Ecuador: A time series study

Dante Ayaviri Nina[1], Joselin Cevallos Briones[1], Gabith Quispe Fernandez[1], José Miguel Giner Pérez[2]

Facultad de Ciencias Políticas y Administrativas, Centro de Investigación para la Innovación y Desarrollo Regional, Universidad Nacional de Chimborazo (UNACH), Ecuador[1]
Departamento de Economía Aplicada y Política Económica, Universidad de Alicante, España[2]

Keywords:
Economic sectors, gross value added, GDP, Ecuador, cointegration.

ABSTRACT

This study determines the relationship between the aggregate GDP and the economic sectors of Ecuador in the period 2000-2018, through a time series analysis. The analysis is performed from two approaches: first, through a multiple linear regression model that allows determining the relationship between variables, and second, through an independent cointegration analysis for each set of variables. The dependent variable corresponds to GDP by the production approach and six independent variables that group the Gross Value Added. The results highlight manufacturing as the activity with the highest relationship with GVA, where by increasing manufacturing GVA by one percentage point, GDP will increase by 0.33 percentage points. Cointegration analysis is performed for each set of variables, and highlights trade as the only activity that shares a common trend with GDP.

1. INTRODUCTION

The Gross Domestic Product by production approach (aggregate GDP) is a variable that allows explaining the endogenous economic growth of a country, due to the fact that it reflects the Gross Value Added (GVA) of the economic sectors that comprise it [45], [13], [5], [23]. In addition, it examines the relative importance of each sector in the economy. Thus, it is necessary to ask which economic sector is the most important. One could agree with the thinking of [47], who states that the primary sector is evident for the promotion of economic growth since, by exporting primary products, it is possible to obtain resources to invest in industrialization and technological progress, so manufacturing growth is fundamental to increase economic growth.

From another perspective, the tertiary sector is increasingly immersed in the development of economies and its participation has increased considerably [31]. Moreover, World Bank indicators show the tertiary sector as the strongest sector, followed by the secondary and primary sectors. This can be corroborated by analyzing the value added as a percentage of GDP of each sector in the period 2000-2018. On the one hand, the value added of the primary sector as a percentage of GDP has remained below 5%, and the value added of the secondary sector as a percentage of GDP does not exceed 30%. Meanwhile, the tertiary sector at the

global level has been characteristic, since it has not only maintained a growing trend, but also exceeds 60% of the value added as a percentage of GDP in the period analyzed (World Bank, 2018).

In Latin America, it is possible to distinguish groups of countries that maintain a high participation of the primary sector in the GDP, where their production is focused on agriculture, mining and oil, so it could be assumed that economic growth in Latin America is linked to the development of the primary sector [41], [46], [44]. In this regard, [47] indicates that Latin America assumes the role of supplier of raw materials, and stresses that it is necessary to direct the resources obtained from primary exports in order to motivate the import of capital goods for industrialization. [51] add to this thought, explaining that the agricultural sector generates by-products that could be transformed into finished products; the influence of raw materials in Latin American countries, evidencing that in the boom from 2000 to 2014 their exports of raw materials increased. However, due to the current slowdown in world trade and the drop in the prices of raw material, Latin America's economic growth is affected [33], [34].

For many years, Ecuador was considered a supplier of raw materials. Since its beginnings, cocoa, bananas and oil were the main products for export [20], and therefore, the main generators of economic growth [54]. According to statistical information from the Central Bank of Ecuador (CBE), in the period 2000-2018, the primary sector maintained 19% average share of GVA in aggregate GDP, while the secondary and tertiary sectors accounted for 24% and 53% average share of GVA in aggregate GDP, respectively (CBE, 2019). Clearly, it could be inferred that the tertiary sector is the most influential in the generation of value added in Ecuadorian GDP. However, it is necessary to know the relationship between each economic activity and aggregate GDP and to identify which of them constitutes a strategic sector for the country's economic growth.

As can be imagined, the analysis of the sectors has several directions and according to the approach in which it is developed, different results will be found for analyzing the participation in tax collection of the sectors [12], the influence of sectoral specialization on value added [27], the productive efficiency of independent sectors [9], [16], [26], [42], [1], or the appropriate strategies for each sector at the business level [28]. Reasonably, the elementary way to measure the economic growth of a country is through the evolution of GDP figures. However, beyond knowing what the GDP figures are, it is necessary to know what caused them. For this reason, it is significant to analyze the relationship between aggregate GDP and the activities that make up the economic sectors. This makes it possible to expose the common trend between the variables and highlight the relative importance of each economic activity. In this way, it is possible to identify the most outstanding or influential activities in the Ecuadorian economy, and to conduct new research towards the study of the economic activities determined as influential. Thus, it is intended to determine the relationship between aggregate GDP and economic sectors in the period 2000-2018.

2. Research Background

Economic sectors are key to understanding the economic structure of a country since they show the activities with the greatest generation of added value and the greatest participation in the economy. For this reason, several studies that focus their analysis on sectors seek to determine which sector or economic activity causes greater growth in an economy [3], [11], [18], [37], [42], [49]. From an endogenous context, economies move through the evolution of three basic sectors: primary, secondary and tertiary (World Bank, 2018; [52]. However, despite the fact that all economies keep the same sectors not all are influenced by the same ones, i.e., not all economies obtain the same levels of economic growth with the boost of a certain activity or economic sector, and this is due to the heterogeneity of sectors in emerging economies and advanced economies [8], [35], [32].

Thus, several studies admit that a productive primary sector is a fundamental basis for the promotion of other sectors, since this sector provides raw materials so that other sectors can develop their activities [18], [47], [51], [14]. However, economic theory points to the secondary or industrial sector as the engine of economic growth, due to its contribution in economies of scale and the positive linkages it presents. Industry allows for greater diversification, authors such as [38], [43], [50], [57], [36], argue that the economic growth of countries seems to be more linked to the growth of the industrial sector than that of the other sectors. On the other hand, the tertiary sector is currently taking on greater importance, as the services it contains are required in the other sectors for their performance [4]. In this regard, [11] identify tertiary sector activities as the most dynamic in economies.

This research addresses the general idea that not all economic activities can induce positive effects on others, highlighting the importance of determining the key or strategic sectors in an economy, since when they are encouraged, economic growth will be boosted [22], [24], [21], [48]. On the other hand, they present a sectoral analysis from a business perspective, where economic sectors are analyzed through a financial evaluation identifying those sectors with a greater relative participation in the market and competitiveness [15], [28], [30].

In the same research trend, [12] shows an analysis of the economic sectors that generate higher tax revenue in Ecuador, identifying services, other services and trade as those with the highest fiscal contribution; also emphasizes the analysis for its part, emphasizes its analysis of sectors through cointegration equations and unit root tests, which allow identifying the degree of association that each economic sector maintains with respect to GDP [11], [39].

From another perspective, sectoral analysis can be carried out by identifying the value added generated by each economic activity and its share in the gross domestic product. In Ecuador, this indicator is known as Gross Value Added (GVA), which is formulated as the difference between the total production of an industry and the value of intermediate consumption used for such production [10], [58], [25]. Thus, several researches use GVA as the main indicator to evaluate the economic activity of a country, either to analyze the behavior of a single sector or to relate it to other relevant variables in economies [53], [40], [29]. These studies are significant for the development of the present research, as they give way to the analysis of economic sectors from different approaches.

3. Methodology

The study is based on the analysis of the relationship between the aggregate GDP and the economic activities that make up the sectors of the Ecuadorian economy; therefore, the analysis allows corroborating the hypothesis that points to manufacturing as the engine of growth in an economy. It corresponds to a descriptive and correlational type of research, since it starts with the study of the aggregate GDP and the economic sectors of Ecuador, describing the behavior and evolution of the variables. Therefore, the identification of the relationship between aggregate GDP and economic activities gives way to correlational research, which allows identifying the most influential economic activity for the growth of the Ecuadorian economy.

The population corresponds to the historical series of Gross Value Added of the eighteen economic activities that make up the Ecuadorian aggregate GDP published by the Central Bank of Ecuador since 2000. Based on these series, the sample is considered to be the quarterly GVA figures at constant prices of the economic activities whose share of GVA over the aggregate GDP is greater than 6.5% in the period 2000-2018. The processing of the information is carried out using the EViews 10 statistical package,

applying multiple linear regression to estimate the relationship between the variables, and applying cointegration tests to verify the possible long-term relationship between the variables.

4. Results

The GVA or Gross Value Added shows the final result that each economic activity obtained in its production once intermediate consumption is discounted, that is, the GVA shows the value added that each of the economic activities produced. Therefore, the regression model is determined by the economic activities with the highest share of GVA in the aggregate GDP in the period 2000-2018, in this way, through the regression analysis it is possible to determine the economic activity that maintains a greater relationship with the GDP from the approach of value-added generation.

For the formulation of the regression model, the eighteen economic activities that make up the three economic sectors of Ecuador are used as a basis. However, in order not to bias the model, only the most representative variables for the Ecuadorian economy will be used. Therefore, variables whose share of GVA in aggregate GDP is greater than 6.5% are used. Therefore, the variables to be used in the model are: Manufacturing (11.84%), Commerce (10.50%), Petroleum and mining (10.38%), Construction (8.57%), Education Social services and health (8.22%), Agriculture (7.86%), Other services (7.37%) and Transportation (6.73%), shown in Table 1.

Table 1. Study variables (independent).

Economic activities	**of GDP**
Agriculture	7,86%
Oil and mining	10,38%
Manufacturing (except petroleum refining)	11,84%
Construction	8,57%
Trade	10,50%
Transportation	6,73%
Education Health and social services	8,22%
Other Services (*)	7,37%

Note: (*) It includes Real estate activities and Entertainment, recreation and other service activities.
Source: own elaboration based on ECB data (2020).

In this way, the multiple linear regression focuses on those activities that have generated greater gross value added in the Ecuadorian economy during the period 2000-2018. Therefore, the regression model is established with 8 independent variables divided into 2 activities of the primary sector, 2 activities of the secondary sector and 4 activities of the tertiary sector, expressed in the equation:

$$Y_t = \beta_0 + \beta_1 X1_t + \beta_2 X2_t + \beta_3 X3_t + \beta_4 X4_t + \beta_5 X5_t + \beta_6 X6_t + \beta_7 X7_t + \beta_8 X8_t + \varepsilon_t$$

Where:
$Y = \text{PIB}_t$ Gross Domestic Product by production approach at constant prices
$X1_t = AG_t$ Gross Value Added of Agriculture at constant prices
$X2_t = PE_t$ Gross Value Added of Petroleum and mining at constant prices
$X3 = MF_t$ Gross Value Added of Manufacturing (except petroleum refining) at constant prices
$X4_t = CT_t$ Gross Value Added of Construction at constant prices
$X5_t = CO_t$ Gross Value Added of Trade at constant prices
$X6_t = TR_t$ Gross Value Added of Transportation at constant prices

$X7_t = EN_t$ Gross Value Added of Education Social and health services at constant prices
$X8_t = OT_t$ Gross Value Added of Other Services at constant prices
$\varepsilon_t =$ Random disturbance
$t =$ Quarterly

- Long-term relationship

Within the analysis of the relationship between aggregate GDP and economic activities, it is appropriate to perform cointegration tests where two variables will be cointegrated if there is a long-term relationship, or equilibrium, between them [45]. If this is the case, a long-run relationship between the variables would indicate that aggregate GDP and economic activities advance in parallel over time or that they maintain an equilibrium relationship.

To determine whether or not there is a long-run relationship between aggregate GDP and some economic activity, two cointegration methods are used. On the one hand, the unit root analysis of each variable based on the Dickey-Fuller statistic, where if two variables are not stationary and the residuals of the regression between them are stationary. I(1) and the residuals from the regression between them are stationary I(0), then cointegration exists. On the other hand, the cointegration of the variables is analyzed through a cointegration regression also known as the Engel-Granger two-step method [56], [17]. In this case, through the cointegration regression two cointegration contrasts are analyzed in order to determine the existence or not of a long-run relationship between the variables.

4.1 Estimation of the econometric model

For the H1 hypothesis: Manufacturing is the most influential economic activity in the Ecuadorian economy in the period 2000-2018, a multiple linear regression is used to determine the relationship between GDP and GVA of the most representative economic activities. Authors such as [55] support this method of analysis for the Ecuadorian case, said authors apply a multiple regression model to explain the behavior of variables referring to economic sectors. The econometric model is made up of nine variables, eight independent variables that correspond to the GVA of the most representative economic activities, and a dependent variable that corresponds to the GDP by production approach. Initially, to run the model, a logarithmic transformation is applied to the economic series of the model in order to stabilize the variance, obtaining the following expression:

$$\mathrm{LnPIB_t} = \beta_0 + \beta_1 \mathrm{LnAG_t} + \beta_2 \mathrm{LnPE_t} + \beta_3 \mathrm{LnMF_t} + \beta_4 \mathrm{LnCT_t} + \beta_5 \mathrm{LnCO_t} + \beta_6 \mathrm{LnTR_t} + \beta_7 \mathrm{LnEN_t} + \beta_8 \mathrm{LnOT_t} + \mu_t$$

Table 2 shows the first regression model run, in which the significance of the variables is analyzed in order to determine if the model itself is significant, the following relationship coefficients are determined:

Table 2. First regression model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGAG	0.066588	0.035780	1.861061	0.0671
LOGPT	0.108409	0.011180	9.696463	0.0000
LOGMF	0.235939	0.051765	4.557919	0.0000

LOGCT	0.096308	0.011199	8.599534	0.0000
LOGCO	0.247770	0.045179	5.484210	0.0000
LOGTR	0.075222	0.033411	2.251432	0.0276
LOGEN	0.161671	0.027877	5.799430	0.0000
LOGOT	0.075429	0.039458	1.911629	0.0602
C	1.410093	0.370923	3.801573	0.0003

R-squared	0.999166	Mean dependent var	16.43238
Adjusted R-squared	0.999066	S.D. dependent var	0.216612
S.E. of regression	0.006619	Akaike info criterion	-7.086870
Sum squared resid	0.002936	Schwarz criterion	-6.810862
Log likelihood	278.3011	Hannan-Quinn criter.	-6.976564
F-statistic	10031.26	Durbin-Watson stat	0.816217
Prob(F-statistic)	0.000000		

Source: own elaboration based on ECB data (2020).

The model allows determining the significant variables of the model according to the probability of the t-statistic contract. In order to identify the most representative variables and choose to include them in the analysis, the following criteria are used: Ho- Probability t-Statistic > 0,05 → not significant; Hl- t-Statistic probability < 0.05 → significant. Therefore, there are two variables that do not meet the probability to be significant, the LOGAG variable that corresponds to the GVA of agriculture has a probability of 0.0671 > 0.05 so it is not significant for the model. On the other hand, the LOGOT variable that corresponds to the GVA of other services presents a probability of 0.0602 > 0.05 indicating that it is not significant. Based on these results, it is determined that the LOGAG and LOGOT variables should be omitted in the final model, resulting in the regression model shown in Table 3.

Table 3. Second regression model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGPT	0.127347	0.007629	16.69319	0.0000
LOGMF	0.282802	0.048290	5.856307	0.0000
LOGCT	0.094741	0.011431	8.287798	0.0000
LOGCO	0.238032	0.045649	5.214363	0.0000
LOGEN	0.156898	0.028407	5.523266	0.0000
LOGTR	0.114118	0.027809	4.103678	0.0001
C	2.133445	0.148538	14.36292	0.0000

R-squared	0.999101	Mean dependent var	16.43238
Adjusted R-squared	0.999023	S.D. dependent var	0.216612
S.E. of regression	0.006770	Akaike info criterion	-7.065071
Sum squared resid	0.003162	Schwarz criterion	-6.850399
Log likelihood	275.4727	Hannan-Quinn criter.	-6.979278
F-statistic	12785.45	Durbin-Watson stat	0.801934
Prob(F-statistic)	0.000000		

Source: own elaboration based on ECB data (2020).

When analyzing the data of the second model, it can be identified that all the variables maintain a probability < 0.05, so the null hypothesis is rejected and it is asserted that the variables are significant for the model. On the other hand, the value of the R2 and the adjusted R2 are 0.99 almost perfect; this is due to the fact that the economic activities are part of the GDP. However, it is necessary to emphasize that the purpose of the research is to identify the relationship of each activity, allowing to find the activity that is most influential for the Ecuadorian economy.

4.2 Regression estimates

Once the assumptions of the regression model have been contrasted and the optimal model has been established, Table 4 is presented, showing the existing relationships between GDP and GVA of the most influential economic activities in the Ecuadorian economy.

Table 4. Regression Model Estimates

Variable		Coefficient	Std. Error	t-Statistic	Prob.
LOGPT	Oil and mining	0.122769	0.014433	8.506.400	0.0000
LOGMF	Manufacturing	**0.330450**	0.067558	4.891.384	0.0000
LOGCT	Construction	0.095352	0.017841	5.344.448	0.0000
LOGCO	Trade	0.182007	0.045017	4.043.109	0.0001
LOGTR	Transportation	0.170640	0.035927	4.749.673	0.0000
LOGEN	Education, health and social services	0.106897	0.022337	4.785.657	0.0000

Source: own elaboration based on ECB data (2020).

Assuming that all the variables introduced in the model are significant, it is possible to analyze the relationships between the variables. According to the data obtained from the regression model, it is determined that by increasing the GVA of oil and mining by one percentage point, GDP will increase by 0.12 percent. With respect to manufacturing economic activity, it has a strong relationship with GDP. In fact, the strongest in the model, indicating that for every percent increase in manufacturing GVA, GDP will increase by 0.33 percent. On the other hand, construction has the lowest relationship in the model, indicating that for every percent increase in construction GVA, GDP will increase by 0.09 percent.

In turn, trade activity shows the second strongest relationship, since for every percent increase in the GVA of trade, GDP will increase by 0.18 percent. For the transportation sector, it is established that for every percent increase in the GVA of transportation, GDP will increase by 0.17 percent. Meanwhile, for the education, social and health services sector, it is established that for every percent increase in the GVA of education, social and health services, GDP will increase by 0.10 percent.

4.3 Cointegration analysis

This section seeks to test the existence of cointegration between the variables in two ways. The first form of cointegration analysis is through a stationarity analysis by means of the Dickey-Fuller unit root test presented in Table 5, and the second form is through an Engel-Granger cointegration regression model presented in Table 6.

Table 5. Unit root cointegration test.

Variable		Unit root		Order of integration	Regression Prob.Level*.	Cointegration
		Prob-Level	Prob- 1st difference			
GDP	LOGPIB	0,3981	0,0000	I (1)	-	-
Oil and mining	LOGPT	0,1969	0,0000	I (1)	0,6353	NO
Manufacturing	LOGMF	0,6442	0,0000	I (1)	0,1171	NO
Construction	LOGCT	0,1617	0,0000	I (1)	0,1553	NO
Trade	LOGCO	0,4696	0,0000	I (1)	0,0000	YES
Transportation	LOGTR	0,9863	0,0000	I (1)	0,1668	NO
Education, social services and health	LOGEN	0,9646	0,0001	I (1)	0,0394	YES

Note: (*) Corresponds to the probability in levels of a regression between variables.
Source: own elaboration based on ECB data (2020).

Table 5 shows the results of the cointegration tests through the stationarity analysis of the variables, through the identification of the unit root by the Dickey-Fuller contrast. To determine whether GDP is cointegrated with any of the activities, two requirements must be met: first, both variables must be of the same order of integration, and second, a combination of them must be stationary, that is, integrated of order zero I(0). Well, the cointegration detection process is carried out for each of the independent variables with respect to the dependent variable.

The dependent variable LOGPIB presents a probability of 0.3981 > 0.05 evidence in favor of the null hypothesis indicating that there is at least one unit root, so the unit root test is performed in first differences having as a result a probability of 0.0000 < 0.05 evidence against the null hypothesis rejecting the existence of another unit root, so the variable LOGPIB is I (1).

For its part, LOGPT presents a probability of 0.1969 > 0.005 evidence in favor of the null hypothesis indicating that there is at least one unit root, in the first differences test a probability of 0.0000 < 0.05 evidence against the null hypothesis rejecting the existence of another unit root so LOGPT is I (1). Regarding LOGMF, in levels, presents a probability of 0.6442 > 0.05 evidence in favor of the null hypothesis that the variable contains at least one unit root. Then, the test was performed in first differences where the probability was 0.0000 < 0.05 evidence against the null hypothesis rejecting that the variable LOGMF contains some other unit root, so LOGMF is I (1).

Consequently, the analysis of the variable LOGCT results in a probability of 0.1617 > 0.05 indicating that there is at least one unit root, while the first differences test determined a probability of 0.0000 < 0.05 evidence against the null hypothesis that there are more unit roots, so LOGCT is I (1).

Meanwhile, the analysis for the LOGCO variable determined that it is I (1) because the probability of the analysis in first differences was 0.0000 < 0.05 evidence against the existence of another unit root. The LOGTR variable presented a probability of 0.9863 > 0.05 evidence in favor of the existence of at least one unit root, while in first differences the probability was 0.0000 < 0.05, showing that the LOGTR variable is I (1). Finally, the variable LOGEN presented a probability of 0.9646 > 0.05 evidence in favor of the null hypothesis, so the analysis in first differences determined a probability of 0.0000 < 0.05 establishing that LOGEN is I (1).

The analysis of the order of integration shows that all the study variables are not stationary, that is, they are integrated of order one I (1). In this case, when analyzing the data in Table 12, it is identified that the LOGCO and LOGEN variables present cointegration. On the one hand, LOGCO which represents trade activity is I (1) as well as LOGPIB fulfilling the first requirement, then a combination of both obtained from a linear regression proves that it is stationary I(0) fulfilling the second requirement and indicating that there is a long term relationship between GDP and trade activity. Similarly, LOGEN, which represents the activity of education, social services and health, maintains the same order of integration of the dependent variable, and also the combination of both through a regression is stationary I(0), so it also presents a long-term relationship.

Table 6. Cointegration test through cointegration regression.

Variable		Coefficient-Regression-Cointeg .	Prob. Cointegration Test - Engle-Granger	Prob. Cointegration Test - Phillips-Ouliaris	Cointegration
GDP	LOGPIB		-	-	-
Oil and mining	LOGPT	0,913984	0,8310	0,8554	NO
Manufacturing	LOGMF	1,048695	0,2774	0,1717	NO
Construction	LOGCT	0,661301	0,3463	0,2117	NO
Trade	LOGCO	1,187064	0,0002	0,0057	YES
Transportation	LOGTR	0,916603	0,3664	0,3155	NO
Education, social services and health	LOGEN	0,855391	0,1194	0,1416	NO

Source: own elaboration based on ECB data (2020).

Table 6 shows the results of the Engel-Granger and Phillips-Ouliaris cointegration existence probability. In this case, a set of propositions arises: HO: The series are not cointegrated; H1: The series are cointegrated.

For this case, a cointegration regression was performed for each of the variables identifying the probability of the existence of cointegration in each of them. The probability of the LOGPT variable is analyzed where E-G is 0.8310 and P-O is 0.8555 both > 0.05 evidence in favor of the null hypothesis indicating that the LOGPIB and LOGPT variables are not cointegrated. LOGMF presented an E-G probability of 0.2774 and P-O of 0.1717, both > 0.05, evidence in favor of the non-existence of cointegration between the LOGPIB and LOGMF variables. Regarding the LOGCT variable, the E-G probability was 0.3463 and P-O 0.2117 > 0.05, evidence in favor of the null hypothesis indicating that there is no long-term relationship between LOGPIB and LOGCT.

The analysis for the LOGCO variable, which corresponds to trade activity, presents a probability of 0.0002 < 0.05 in the E-G contrast, rejecting the null hypothesis and determining that there is cointegration between the LOGPIB and LOGCO variables. On the other hand, the Phillips-Ouliaris contrast presents a probability of 0.0057 < 0.05 corroborating that there is indeed cointegration or long-term relationship between the GDP and trade variables.

From another point of view, the LOGTR variable presented a probability of 0.3664 in E-G and 0.3155 in P-O both > 0.05 presenting evidence in favor of the null hypothesis on the existence of cointegration between the variables. On the other hand, the LOGEN variable presented a probability of 0.1194 in E-G and 0.1416

in P-O both > 0.05, evidence in favor of the null hypothesis indicating that the LOGPIB and LOGEN variables do not present a long-term relationship.

5. Discussion

The results of the multiple linear regression show that for the Ecuadorian case, manufacturing is the activity with the highest relationship, considering that by increasing the GVA of manufacturing by one percentage point, GDP will increase by 0.33 percent. These results allow determining that manufacturing is the most representative activity for the country, coinciding with the results of [57], [36], [43], where it is evident that the manufacturing sector is highly influential for economies, due to the fact that it presents positive linkages and is also a highly value-added generating sector.

It should be noted that in terms of gross value added, the results are quite significant and in agreement with economic theory, since the high participation of manufacturing GVA in the country's GDP growth is evident. On the other hand, the results of the multiple linear regression model show that increasing the GVA of commerce by one percent will increase GDP by 0.18 percent, making commerce the second most influential activity in the Ecuadorian economy. At present the service sector especially commerce remains in a position of growth, the activities of the tertiary sector are indispensable for the proper functioning of the other sectors [2], [11]. In this way, the multiple linear regression analysis allowed the determination of the relationships between the variables, with which it was possible to demonstrate that manufacturing and commerce are the two most influential economic activities in the Ecuadorian economy. In other words, in global terms, the secondary sector and the tertiary sector are the most representative for the country.

The cointegration analysis was performed by two methods, through the stationarity analysis of the variables and through the contrasts of a cointegration regression. The purpose of the cointegration analysis is to strengthen the results of the multiple linear regression. Thus, the results of the cointegration analysis show trade as the only activity with a long-term relationship with GDP, which is in agreement with the research of [11], which shows the service sector as the most influential for the economy under study, while manufacturing, despite being the activity with the highest relationship, does not have a long-term relationship with GDP, i.e., they do not move together over time [19], [11].

These results allow to affirm that the Ecuadorian economy is more closely linked to the development of the tertiary sector, specifically with the activity of commerce, due to the fact that this activity is the second with the strongest relationship and, in addition, it is the only activity that presents a long-term relationship.

6. Conclusions

Since its beginnings, Ecuador has stood out as a supplier of raw materials, since its participation in the world economy is focused on the export of primary products such as cocoa, bananas, shrimp, flowers and, of course, oil. This background allows inferring that the most representative economic activities for Ecuador are within the primary sector. However, when analyzing the share of GVA of each of the economic activities, it can be shown that activities such as manufacturing and commerce have a greater share in the Ecuadorian economy. Thus, for the period analyzed, the three most representative economic activities in terms of GDP were manufacturing with 11.84%, commerce with 10.50% and oil and mining with 10.38%.

Through multiple regression analysis, the relationship between GDP and GVA of the most representative economic activities for the Ecuadorian economy was determined. This analysis showed that manufacturing is the most representative economic activity for the country, whose relationship indicates that by increasing the GVA of manufacturing by one percentage point, GDP will increase by 0.33 percentage points. For its

part, commerce was positioned as the second most influential activity in the Ecuadorian economy, where for each percentage point increase in the GVA of commerce, GDP will vary in the same direction by 0.18 percentage points. It should be noted that GVA data reflect the residuals between total production and intermediate consumption of the economic activity in a given period, which leads to the conclusion that manufacturing, being a value-added generating activity, is a key activity for the country's economic growth.

The results allow to conclude that there is a long-term relationship between GDP and the economic activity of commerce, since for both the Engel-Granger and Phillips-Ouliaris tests the probability was very low, demonstrating the existence of cointegration. In the case of manufacturing, despite presenting a high relationship in the multiple regression analysis, the same is not true for the cointegration regression analysis, since it does not present a long-term relationship with GDP.

7. References

[1] Acosta, N., Rodríguez, S. and Bastidas, R. (2021). The effect of increasing land value capture on the gross value added of the construction sector. Applied Economics Letters, 28(1):65-69.

[2] Aguayo, E. y Álvarez, L. (2007). Análisis econométrico del sector servicios en las regiones de México, 1993-2001. Investigación Económica, LXVI(261):35-60.

[3] Agurto, A. (2018). Relación entre crecimiento económico y manufactura en Ecuador usando técnicas de cointegración. Revista Económica, 4(1): 67-79.

[4] Ahmed, A. (2013). Effects of financial liberalization on financial market development and economic performance of the SSA region: an empirical assessment. Economic Model,30:261–73.

[5] Anghelache, C., Soare, D.V. and Popovici, M. (2015). Analysis of Gross Domestic Product Evolution under the Influence of the Final Consumption. Theoretical and Applied Economics, XXII (4):45-52.

[6] Banco Central del Ecuador. (2019). Información Estadística Mensual No. 2015: Enero 2020. Quito. Ecuador.

[7] Banco Mundial. (2018). Indicadores Económicos. Ministerio de Economía y Finanzas, Quito.

[8] Barro, R. y Redlick, C. (2011). Macroeconomic Effects from Government Purchases and Taxes, The Quarterly Journal of Economics, 126(1):51-102.

[9] Bravo, J. y Cuzme, K. (2012). Análisis sectorial de la industria textil ecuatoriana y diseño de un modelo de planeación estratégica para la empresa Modatex S.A. Universidad Politécnica Salesiana, Ecuador.

[10] Brito, L., Sotomayor, G. y Apolo, J. (2019). Análisis y perspectivas del valor agregado bruto en la economía ecuatoriana. X-Pedientes Económicos, 3(5):17-36.

[11] Castillo, R., Flores, C. and Rodríguez, M. (2014). The Relative Importance of the Service Sector in the Mexican Economy: A Time Series Analysis. Lecturas Económicas, (80):133-151.

[12] Choca, W. (2014). Análisis de los sectores económicos que generan una mayor recaudación al Servicio de Rentas Internas del Ecuador, periodo 2007-2012. Universidad de Guayaquil, Ecuador.

[13] Cisneros, J. (2014). Revisión del método del ingreso del PIB y planteamiento de una propuesta para expresar los principales indicadores macroeconómicos. Documento de Trabajo OMEGA BETA GAMMA. Perú.

[14] Colman, P., Harwell, J. and Found, P. (2020). Value creation through innovation in the primary sector. International Journal of Quality and Service Sciences, 12(4):475-487.

[15] Correa, J., Castaño, C. y Mesa, R. (2011). Panorama financiero empresarial en Colombia 2009-2010: un análisis por sectores. Perfil de Coyuntura Económica, (18):145-165.

[16] Crespo, H. (2016). Análisis de la productividad del sector manufacturero ecuatoriano durante el periodo 2014. Universidad Católica de Santiago de Guayaquil, Ecuador.

[17] Christopher, B. (2015). Residual diagnostics for cross-section time series regression models, The Stata Journal, 1(1):101-104.

[18] Cruz, M. y Polanco, M. (2014). El sector primario y el estancamiento económico en México. Revista Problemas del Desarrollo, 45(178):9-33.

[19] Doz, C., Giannone, D. and Reichlin, L. (2012). A Quasi–maximum Likelihood Approach for Large, Approximate Dynamic Factor Models, The Review of Economics and Statistics, 94(4):1014–1024.

[20] Falconí-Benítez, F. (2001). Integrated Assessment of the Recent Economic History of Ecuador. Population and Environment: A Journal of Interdisciplinary Studies, 22(3):257-280.

[21] Figueroa, C. (2015). Identificación de los sectores clave de la economía mexicana. Investigación y Ciencia, 23(65):48-58.

[22] Fuentes, N. (2003). Encadenamientos insumo-producto en un municipio fronterizo de Baja California, México. Frontera Norte, 15(29):151-184

[23] Garin, J., Lester, R. and Sims, E. (2016). On the Desirability of Nominal GDP Targeting. Journal of Economic Dynamics and Control, 69:21-44.

[24] González, R., Díaz, M. y Leal, F. (2010). Identificación de sectores estratégicos en la economía de Aguascalientes. Investigación y Ciencia, 18(49):40-47.

[25] Herrera-Granda, I., Lorente-Leyva, L., Peluffo-Ordoñez, D. and Alemany, M. (2020). A Forecasting Model to Predict the Demand of Roses in an Ecuadorian Small Business Under Uncertain Scenarios. Lecture Notes in Computer Science, 12:245-258.

[26] Jin, S., Lim, S. and Yoo, S. (2016). Causal relationship between oil consumption and economic growth in Ecuador. Economics, Planning and Policy, 11(9):782-787.

[27] Jiménez, S. y Alvarado, R. (2017). Especialización sectorial, capital humano e ingreso regional en Ecuador. Revista de Estudios Regionales, (111):99-128.

[28] Jurado, M. (2016). Sectores de la economía ecuatoriana desde una perspectiva empresarial: aplicación de la Matriz Boston Consulting Group (BCG). Revista Publicando, 3(8):266-294.

[29] Kołodziejczak, W. (2020). Employment and Gross Value Added in Agriculture Versus Other Sectors of the European Union Economy, Sustainability, 12:5518.

[30] Liu, P., and Wang, P. (2018). Some q-rung orthopair fuzzy aggregation operators and their applications to multiple-attribute decision making. International Journal of Intelligent Systems, 33(2):259–280. https://doi.org/10.1002/int.21927.

[31] López, A., Ramos, D. y Torre, I. (2009). Las exportaciones de servicios de América Latina y su integración en las cadenas globales de valor. Comisión Económica para América Latina y el Caribe en Santiago de Chile.

[32] Komal, R. an Abbas, F. (2015). Linking financial development, economic growth and energy consumption in Pakistan, Renawable and sustainable Energy Reviews, 33:211-220.

[33] Kristjanpoller, W. and Olson, J. (2014). Economic growth in Latin America countries: is it based on export-led growth or import-led growth? Emerg. Mark. Finance Trade 50(1):6–20. https://doi.org/10.2753/REE1540-496X5001S101.

[34] Kristjanpoller, W.; Olson, J. and Salazar, R. (2016). Does the commodities boom support the export led growth hypothesis? Evidence from Latin American countries. LatinAmerican Economic Review 25(6):1–13. https://doi.org/10.1007/s40503-016-0036-z.

[35] Macchiarelli, C. (2013). Similar GDP-inflation cycles. An application to CEE countries and the euro area. International Business and Finance, 27(1):124-144.

[36] Marconi, N., Fróes de Borja, C. and De Araújo, E. (2016). Manufacturing and economic development: The actuality of Kaldor's first and second laws. Structural Change and Economic Dynamics, (37):75-89.

[37] Mendieta, R. and Pontarollo, N. (2018). Territorial growth in ecuador: The role of economic sectors. Romanian Journal of Economic Forecasting, 21(1):124-139.

[38] Moreno, A. (2008). Las leyes del desarrollo económico endógeno de Kaldor: el caso colombiano. Revista de Economía Institucional, 10(18):129-147.

[39] Nasreen, S.; Anwar, S. and Ozturk, I. (2017) Financial stability, energy consumption and environmental quality: evidence from South Asian economies. Renew Sustain Energy Rev 67:1105–1122. https://doi.org/10.1016/j.rser.2016.09.021

[40] Nemes, G.; High, C. and Augustyn, A. (2018). Beyond the New Rural Paradigm: Project State and Collective Reflexive Agency. In Territorial Cohesion in Rural Europe: The Relational Turn in Rural Development; Copus, A.K., de Lima, P., Eds.; Routledge: Abingdon,

[41] Ortiz, J. (2012). Latin America and its new trade Dependency. This time with China. Lat. Am. Res. Rev, 47(3):175–190.

[42] Ortiz, C., Jiménez, D. y Jaramillo, L. (2020). Productive diversification and structural change in closed and open economies. Lecturas de Economia, (91):11-39.

[43] Palomino, M. (2017). Importancia del sector industrial en el desarrollo económico: Una revisión al estado de arte. Rev. Est. de Políticas Públicas, 4:139-156. http://dx.doi.org/10.5354/0719-6296.2017.46356

[44] Paño, P. (2021). Viabilidad de la economía circular en países no industrializados y su ajuste a una propuesta de economías transformadoras. Un acercamiento al escenario latinoamericano. Revista de Economía Pública, Social y Cooperativa, 10(2):289-323.

[45] Pistoresi, B. and Rinaldi, A. (2012). Exports, imports and growth. Explorations in Economic History, 49(2):241-254.

[46] Pareyón, R. (2015). El sector primario exportador como base para la industrialización en América Latina durante los siglos XIX y XX. Tiempo Económico, 10(29):21-31.

[47] Prebisch, R. (2012). El desarrollo económico de la América Latina y algunos de sus principales problemas. Comisión Económica para América Latina y el Caribe en Santiago de Chile.

[48] Quiñonez, R., García, R., Feria, U., Pérez, K., Agostinho, F. and Giannetti, B. (2020). Construction of the input-product matrix of the Esmeraldas Province, Republic of Ecuador. Estudios de Economia Aplicada, 38(2):45-56.

[49] Quintana, L., Correa, R., Mendieta, M. and Álvarez, J. (2019). Sectoral regional growth and convergence in Ecuador: An analysis of the intra-distributive dynamics of productivity. Symmetry, 11(4): 461-476.

[50] Quintana, R., Rosales, A. y Mun, N. (2013). Crecimiento y desarrollo regional de México y Corea del Sur: un análisis comparativo de las leyes de Kaldor. Investigación Económica, 72(284): 83-110.

[51] Riveros, H. y Heinrichs, W. (2014). Valor agregado en los productos de origen agropecuario: aspectos conceptuales y operativos. Instituto Interamericano de Cooperación para la Agricultura en Costa Rica.

[52] Schmidtke, T., Koch, H. y Camarero, V. (2018). Los sectores económicos en América Latina y su participación en los perfiles exportadores. Fundación Friedrich Ebert en México.

[53] Schneider, F.; Kallis, G. and Martinez-Alier, J. (2010). Crisis or Opportunity? Economic Degrowth for Social Equity and Ecological Sustainability. Introduction to This Special Issue. J. Clean. Prod. 18:511–518

[54] Uquillas, A. (2007). El fracaso del neoliberalismo en el Ecuador y alternativas frente a la crisis, Universidad Central del Ecuador.

[55] Vascones, B. y Villena, N. (2018). La industria de la construcción: su participación en el PIB TOTAL del Ecuador durante el periodo 2012 – 2016. Revista Espacios, 39(16):44-56.

[56] Wallace, F., Lozano-Cortés, R. y Cabrera-Castellanos, L. (2008). Pruebas de cointegración de paridad de poder de compra. EconoQuantum, 4(2):7-25.

[57] Wells, H. and Thirlwall, A. P. (2003). Testing Kaldor's Growth Laws across the Countries of Africa. African Development Banck, 2:89-105.

[58] Zamora, R. y Coello, G. (2015). El valor agregado bruto (VAB) del comercio en la provincia de Tungurahua. Revista de Coyuntura. Observatorio Económico y Social de Tungurahua, 1(2): 7-10.