The Effects of Economic Sector GDP on Low-Income Housing Supply. Colombia's Regions Case

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Article

The Effects of Economic Sector GDP on Low-Income Housing Supply. Colombia´s Regions Case

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Abstract: The regions with the best economy have a greater capacity to develop low-income or social impact housing, thus contributing to the reduction of poverty, and therefore, to the fulfillment of the Sustainable Development Goals. This is observed in fewer people living in extreme poverty and with fewer unmet basic needs. The present article analyzes the correlation between development by the main economic sectors in the different regions (departments) of Colombia, and the offer of low-income housing. The valid relationship found is between the economic condition of the regions (GDP) and non-social housing (more expensive commercial value) (Spearman´s Rho: 0.9). That means that there is an imbalance between regional economic capacity and the low-income housing offer because their economic potential allows them to have less of a demanding population, that is, living in poverty. This correlation is higher with activities that are mostly developed in an urban environment, such as manufacturing, construction, real estate, and finance and insurance. On the contrary, the correlation is lower with industries such as mining and agriculture, which mostly operate in rural areas. The analysis for low-income housing and economic sectors GDP yields low correlations, but are especially dismissible for more rural industries, such as mining and agriculture. The analysis shows the change of trend in the correlations for the year 2021, the beginning of the post-pandemic economic recovery.

Keywords: low-income housing; Gross Domestic Product (GDP); Unmet Basic Needs (UBN); Sustainable Development Goals (SDG)

1. Introduction

The Unmet Basic Needs (UBN) is an indicator that allows identifying the levels of poverty in the regions. The trend in Latin America, and therefore in Colombia, is that in its regions (or departments) with the best economic level (measured from the Gross Domestic Product, GDP per capita) they have the lowest indices of extreme poverty or UBN.

UBN are measured in different socioeconomic aspects, including the material condition of the housing, the lack of basic public services and overcrowding. These aspects are related to the need to generate low-income housing for the population with the greatest needs and thus contribute to reducing their UBN and helping them overcome the condition of poverty. Additionally, the generation of low-income housing contributes to compliance with the SDGs. A review of the 17 Sustainable Development Goals (SDGs) [1] shows that one of the common elements between No. 1 "No Poverty," No. 6 "Clean Water and Sanitation," and No. 11 "Sustainable Cities and Communities" is to generate decent housing for the poorest communities. Whether it is: new home ownership, improved home ownership, or rental housing, but provided with minimum quality standards, help to improve the indicators for these 3 SDGs.

The construction of housing for low-income households is one of the options to help reduce poverty in a developing country such as Colombia, according to the Colombian Ministry of Housing,

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City and Territory (2022) [2], Low-income or Social Interest Housing (VIS, in Spanish term) has the social function of being the lowest priced: "VIS has the elements that ensure habitability and that meet the quality standards of urban, architectural, and construction design. Their maximum value is one hundred thirty-five current legal monthly minimum wages (135 SMLM)." [1]Housing units that, due to their sale price, exceed the VIS value, are called "no-VIS housing," and are not intended to favor low-income households.

The hypothesis posed by this article is that the regions with the highest level of income, Colombia case, are those with a tendency to develop fewer VIS housing units because they have a lower percentage of the population in extreme poverty and with fewer housing needs. This is supported by high correlation values and negative sign (Spearman's Rho < -0.7) for the 33 departments of Colombia (Table 1).

Table 1. Rho value for the correlation between Colombia regions GDPs per capita and UBN conditions., and inhabitants in extreme poverty.

Percentage of UBN inhabitants	Percentage of inhabitants in extreme poverty or misery	Percentage of housing UBN inhabitants	Percentage of basic public services UBN inhabitants	Percentage of overcrowding UBN inhabitants
-0.84	-0.82	-0.75	-0.75	-0.80

A huge social problem is the relationship between economic growth and low-income housing. Is exposed by entities such The Inter-American Development Bank (IDB) by stating that the housing sector, in Latin America and the Caribbean, has historically been affected by the economic situation, as recently demonstrated in the COVID-19 pandemic, and is related to the fulfillment of the Sustainable Development Goals (SDGs). For the IDB is clear that the development of the housing sector is a fundamental tool for sustainable and resilient growth in Latin America and the Caribbean (LAC) [3].

The importance of low-income housing development in order to reduce poverty

It is important to highlight that the good economic situation of the regions has facilitated the reduction of the number of households with housing in poor condition; and to remember that Latin America and the Caribbean is the developing region with the highest level of urbanization in the world. This fact is related to the increase in human settlements and poverty; and housing development is essential for reducing social, economic, and environmental gaps. And it is even more worrying when you read the numbers: "If we add to this the high levels of poverty, labor informality and the slowdown in mortgage financing, we conclude that the probable scenario for the coming years is an expansion of precarious settlements in our region, beyond 17.7% of the population urban society that in 2020 lived in marginal neighborhoods" [4].

In another document, the ECLAC highlights the relationship between urban population growth, economic opportunities, and the housing construction sector: "Population growth presents a negative relationship with economic growth. That is, accelerated population growth presents an opportunity cost in relation to economic growth, since rapid growth in the labor factor means that more capital has to be used to equip the growth of the labor force, which results in in slower growth of capital per worker", and "The construction sector includes both the creation of new homes and the recovery and rehabilitation of those that are disused and/or deteriorated. Its development not only impacts the most vulnerable population. In addition to alleviating poverty, it is a sector of great relevance within the economy, due to the impact it generates on other sectors. On the one hand, it demands from other industries the inputs used in construction works, inducing dynamism in the latter" [5].

According to the Ministry of Labor (Republic of Colombia) (2023) [6], about 70% of inter-municipal migrants, for lack of work reasons, arrived in the following departments: Bogota,

[1] SMLM: legal monthly minimum wage, which amount to 1 million Colombian pesos (COP) in 2022.

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Cundinamarca, Valle del Cauca, Antioquia, Santander, Risaralda, Meta, Atlantico and Tolima. Eight of these nine regions are on the list of those ten with the best GDP per capita since 2015 [7].

Figure 1 shows the strong and positive relationship between the growth of GDP per capita and the GDP of the construction sector, for a sample of 20 Latin American countries, between the years 1990 and 2020.

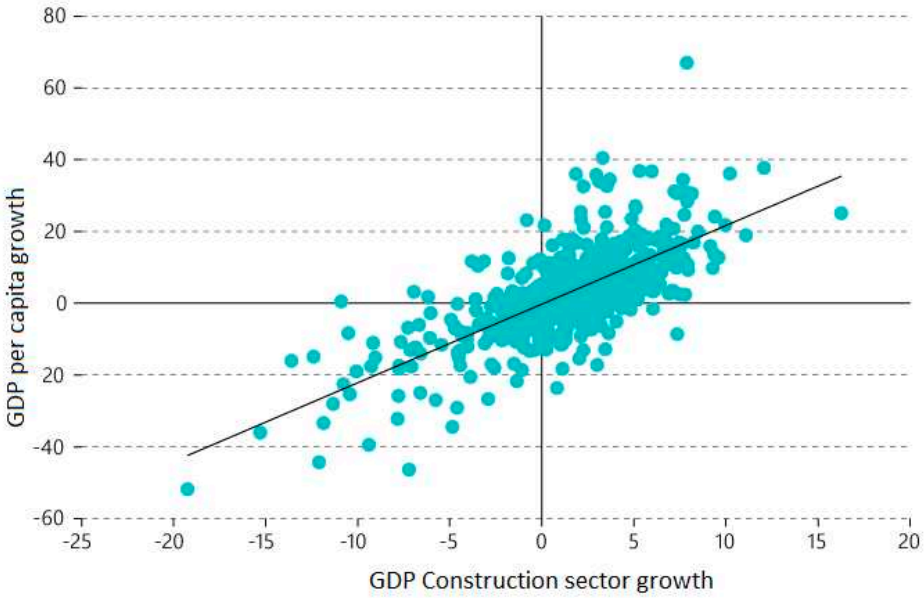

Figure 1. GDP per capita and GDP construction sector growth, in percentage (20 Latin America and Caribbean countries, between 1990 and 2020). Source: ECLAC (2022b).

In Colombian case, when there is an economic crisis, what is built the most is low-income housing (VIS). In order to maintain the construction and housing sales sector, a solvent demand is needed, which is capable of having enough money to buy housing in the middle and upper strata segments. When there is a crisis, demand contracts and that is why the State gives subsidies to leverage that demand and it does so in low-income segments [8].

Now, regarding Latin America and the Caribbean, the importance of producing more quality social housing for the population classified as poor stems from the growth of the urban population coming from rural areas. The United Nations Economic Commission for Latin America and the Caribbean (ECLAC) presents projections for the population of the region and each of its countries [9]. According to the general data for Latin America and the Caribbean, the turning point between a higher percentage of the population living in urban areas compared to rural areas occurred in 1960. Since then, the difference has steadily been increasing and it is projected to remain this way at least until the year 2050 (Figure 2). In the case of Colombia, the distribution of the population is very similar to the above data (Figure 3).

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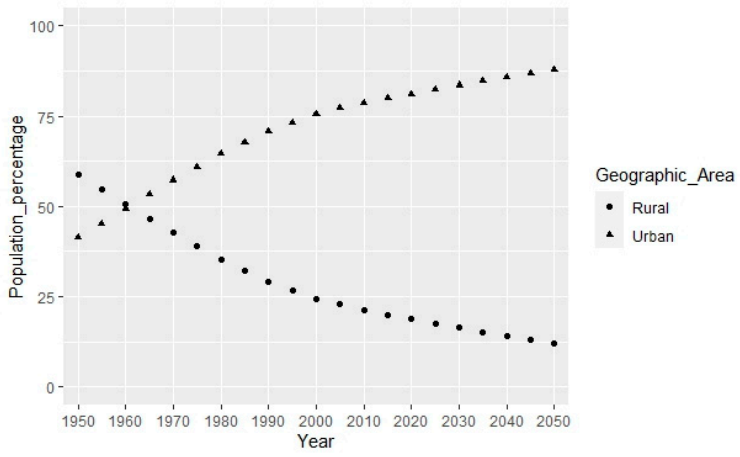

Figure 2. Population percentage distribution in urban and rural areas. Latin America and the Caribbean. Source: ECLAC (2022c).

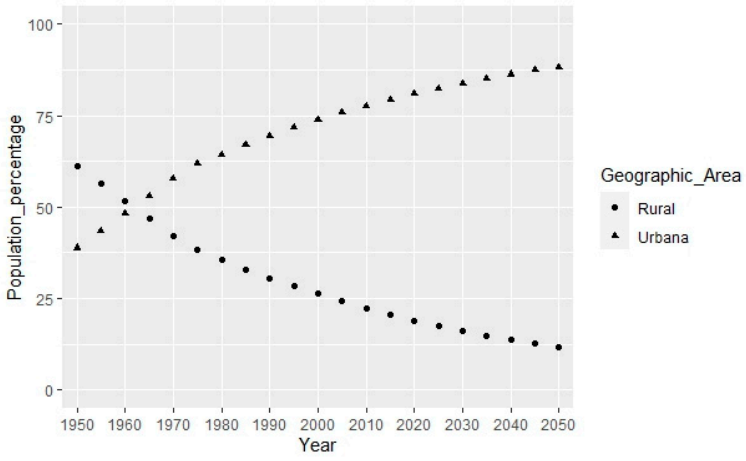

Figure 3. Population percentage distribution in urban and rural areas. Colombia. Source: ECLAC (2022c).

The above suggests that the so-called "urbanization phenomenon" will continue in Colombia and in Latin America, generating a greater number of migrants from rural to urban areas. Most of this migration occurs under conditions of poverty and as a result, families arrive in the municipalities to occupy housing with very poor material conditions and without basic public utilities. Unfortunately, much of the causes of migration are linked to violence and lack of economic and job opportunities in many rural areas [10–12]. In the case of Colombia, although the population living in poverty has decreased since the early 2000s, indicators continue to be higher in rural areas than in urban areas [13]. It is also noteworthy that in recent years, there has been many people living in poverty who have migrated from Venezuela to Colombia, mostly to major cities [14].

A review of the state of the art to explore the relationship between poverty and social housing shows that, according to Chiodelli (2016) [15], the great proliferation of informal human settlements in the major cities of so-called developing countries began after World War II. This informal growth of cities led to poverty, creating what can be described as a "planet of slums" [16]. For several years, government agencies failed to take significant action to address this issue. Only until the 1960s, and with greater force in the 1970s, did various government and multilateral agencies initiate housing policies consistently and with clear objectives to improve the housing conditions of poor households in the cities, to reduce the reality of urban poverty. Over the years, it has been shown that the location of low-income housing in the urban periphery (generated largely by the effects of rural-urban

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migration) results in transportation issues on work or study days due to increased commute time and costs. It also brings restrictions to urban development [17].

The first initiatives to improve social housing focused on having the community itself actively participate in the construction or improvement of their precarious housing. However, the 1980s proved that self-built housing was not a good idea due to the quality of the construction process. From then on, housing policies focused on the fact that the State should intervene even more with new housing projects and provide households with financial planning, financial assistance through subsidies, and even rental housing options. The latter option has not been given due consideration by many governments in poor countries, but it is an option for regulating social housing [18]. In the 1990s and 2000s, agencies such as the World Bank, the Inter-American Development Bank and UN-Habitat have been very active in promoting policies for social housing valuation and land regulation [19]. Such housing policies strengthened the legal ownership of informal housing as a mechanism to reduce the state of poverty of households by increasing their net worth through home ownership [20–22].

Between 1995 and 2009, housing conditions in Latin America improved by reducing the number of households in the housing deficit from 8% to 6%. Similarly, the proportion of occupants living in housing built with precarious materials fell from 12% to 8.8%. These improvements in the housing deficit correspond to an era of economic growth, measured in per capita income. However, criticism must be made of the lack of consistency between public policies for urban development and housing development. This disconnect has led to housing projects not being a solution to the quality of life of the inhabitants [23].

Providing new housing or improving existing housing for lower-income households who cannot afford non-VIS housing is not solely about the actual building. Housing also implies providing basic public services and utilities such as water, sewerage, roads, energy, and adequate public space [24,25]. This implies that social housing in a country contributes to achieving Sustainable Development Goals (SDGs).

Some studies conclude that generating housing invigorates the economy by increasing the Gross Domestic Product (GDP) [26].

The role of low-income housing in the building housing sector

Continuing the study of Latin America, the analysis of the evolution of the economy and social housing in Argentina, Brazil, Chile, and Colombia; concludes that in the last 50 years there has been a lack of response from governments to the problem of social housing. Then there was the expansion of informal settlements and the increase in the social housing deficit. Later, governments wanted to increase financing to reduce the social real estate crisis; and finally, the construction sector participated in an important offer of social housing located in the urban peripheries [27].

The Colombian Chamber of Construction (Camacol)[2] (considered to be the top consulting agency in Colombia for the building industry) has recently stated that "with the reactivation of social housing the expected growth of the economy could be doubled" [28].

The social housing policy in Colombia in recent years has been based on state subsidies to low-income families for the purchase or improvement of social housing. This financial aid encouraged the supply of social housing by construction companies, mainly in the regions of the country that had the greatest demand, that is, regions with greater economic movement and presence of migrant households. Furthermore, the regions or departments of Colombia with the best economy (Cundinamarca, Antioquia, Valle del Cauca and Atlántico) are those that have received the most internal migration of the armed conflict due to having greater employment opportunities, which is why they have developed more social housing projects, reaching low housing deficit rates and the greatest offers of social housing [29].

The relationship between the building construction industry and economic legal monthly minimum wage, has been consistently exhibited in developing countries [30], even in the United States of America [31,32]. Other articles focus the relation between new market housing construction

[2] Colombian Chamber of Construction, Camacol. Available in: https://camacol.co/

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on the low-income housing market [33]. The present study was performed through a statistical validation of the correlation between indicators, employing a nonparametric method. The resulting value of each correlation allowed to establish whether our hypothesis was satisfied, and it determined most of our conclusions for this study.

Another model suggests that per capita income or wage income are not independent variables that explain urban growth; therefore, housing supply should be correlated with population growth. The study was conducted with information from 2001–2016 for the metropolitan areas of the U.S.A. [34].

Bramley & Pawson (2002) [35] establish that demographics, employment, poverty, income, the attractiveness of the area, and the amount of housing stock or housing for rent are the variables that explain the behavior of urban areas with low demand for housing (United Kingdom, UK).

Other documents relate the impact of policies in the low-income housing, like Ha (1994) [36] in Korea case; Ikejiofor (1998) [37] in Nigeria case; Choguill (1993) [38] in Bangladesh case; and Yang et. Al. (2021) [39] in U.S.A. case.

Housing policies with a focus on subsidies for new and existing (but legalized) housing continue until the present decade (2020), and pertain to cases such as Colombia, Chile, Uruguay, and South Africa, among others [15]. Housing policies in Latin America share similarities and can also be individually analyzed on a global scale [40]. It is also important to note that housing policies in developing countries are often implemented differently from those in developed countries [41].

Summarizing, in Latin America results mainly in: (a.) an analysis of housing policies over the last decades [15,18,19]; (b.) a comparative analysis between countries in the region or between developed and developing countries [40,41]; (c.) an analysis of the relationship between housing production and urban public utilities [24,25]; (d.) a review of the spatial characteristics of informal housing and qualitative deficit [17,42–44]; and (e.) an analysis of the relationship between social housing production and urban poverty reduction [20–22,26].

Camacol have analyzed the behavior of the building industry's GDP, both at the national level and by departments, but they do not relate it to the supply of VIS. They have also studied the participation of 60 subsectors of the economy in the demand for goods and services related to the building construction industry; however, they do not relate this information to the number of housing units that are built [45]. More recently, another publication presents a GDP projection for the construction industry but does not correlate other economic industries with housing supply, nor is it analyzed by region [46,47].

The objective of this study was to establish whether there is a statistically valid correlation between the supply of social interest housing (VIS) in a region (per department in Colombia) and socioeconomic and demographic variables such as the general GDP of the department, the main industry-specific GDPs, the general population of the department; based in the hypothesis that the regions with the highest level of income, Colombia case, are those with a tendency to develop fewer VIS housing units be-cause they have a lower percentage of the population in extreme poverty and with fewer housing needs.

After a search for technical articles on social housing demand modeling, we found a correlation analysis between housing production, deficit, and regional socioeconomic variables such as Gross Domestic Product (GDP), and population.

The state of the art makes clear the relationship between poverty and housing condition; and therefore, a contribution to the SDGs. But there are no publications on the analysis of the relationship between indicators at regional level to no one country in Latin America. This study analyzes whether the areas or departments in Colombia with greater economic development are related to a higher number of VIS housing units in the period between 2015 and 2021, making a reading of the contribution to the SDGs from the social building economic sector, according to the regional social and economic condition in Colombia.

This study is based on the trend for well-developed regions which receive an important migrant population, like from rural to urban areas due to social and economic conflicts, are linked to poverty;

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and due to the previous, requires a decent housing solution to reduce the UBN of population, and thus helping improve the indicators of the Sustainable Development Goals (SDGs) [12,48–51].

2. Method

The information used in this study was obtained from the most reliable organizations and governmental agencies in Colombia. All information used is official for Colombia. It was obtained from the most recent reports published by the National Administrative Department of Statistics (DANE).

The first step was to establish whether to use parametric or nonparametric methods to validate the correlations. One of the most commonly used parametric tests is the Pearson correlation coefficient. An important aspect to consider is that in order to apply this method, the normal distribution of the variables to be correlated must be verified beforehand. The resulting coefficient (r) measures the strength or intensity of the linear relationship between 2 variables. To establish whether or not there is a statistically valid correlation, the normality test was initially performed using the "Shapiro–Wilk" command in R Studio, which yields the p-value. The normality of the data distribution can be validated if the p-value is ≥0.05 [52].

The test was applied to the following variables (results are shown in 0):

- Number of licensed VIS units reported for Colombia as a whole and for each of the 33 departments, 2015–2021.
- Number of licensed non-VIS units reported for Colombia as a whole and for each of the 33 departments, 2015–2021.
- Departmental GDP for the manufacturing industry, 2015–2021, for each of the 33 departments.
- Departmental GDP for the construction industry, 2015–2021, for each of the 33 departments.
- Departmental GDP for the real estate industry, 2015–2021, for each of the 33 departments.
- Departmental GDP for the finance and insurance industry, 2015–2021, for each of the 33 departments.
- Departmental GDP for the mining industry, 2015–2021, for each of the 33 departments.
- Departmental GDP for the farming, livestock, forestry, and hunting and fishing (agriculture) industry, 2015–2021, for each of the 33 departments.
- Overall GDP or total departmental GDP, 2015–2021, for each of the 33 departments.

It is worth noting that the housing unit indicator refers to licensed housing, i.e., housing units that potentially will be built, whether new or improved, according to the need to license the projected construction. This indicator does not factor in rental housing solutions or VIS or non-VIS constructions that have been developed without a license. It also does not disregard those that, after being licensed, have not been partially or completely built.

The result indicates that there is no normal distribution for any of the variables analyzed in the 2015–2020 period, in any of the 33 departments (shown in 0).

Since there was no normal distribution for the variables, we performed a nonparametric correlation test, namely Spearman's test. We executed the following command using the R Studio statistical software program:

cor(data_name$dependent_variable,data_name$independent_variable,method = "spearman").

The value or result provided by the Spearman correlation test is rho, whose value measures the intensity of the correlation between 2 variables, and its limits are (-1, 1). If the value is close to unity, the correlation is good and directly proportional between the 2 variables. If the value is close to unity, but is negative (-1), the correlation between the 2 variables is also good but it is inverse. If the value is close to null, it is considered that there is no valid correlation between the variables [53].

We then proceeded to calculate the value of the Spearman correlation (rho) with the data shown in 0, and with these results correlate the number of VIS units/year and the number of non-VIS units/year with:

a. the general economic performance of the country's departments (measured based on the overall GDP), and

b. the economic performance for the main economic industries in Colombia (GDP by industry).

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The conclusions were stablished regarding the hypothesis or assumption that there is a tendency to develop a greater number of social housing units in regions where there is greater economic development, especially in areas where the industrial and service industries are more prevalent.

3. Results

3.1. Correlation between overall GDP and number of VIS housing units by department

Upon performing the data analysis for the 33 departments, low values (rho <0.30) are obtained in 71% of the records (between the years 2016 and 2020), which rules out a statistically valid correlation Table 2. However, a stronger correlation (rho >0.5) is observed for the year 2015 and a very strong one is shown for the year 2021 (rho >0.85).

Table 2. Rho value for the correlation between general GDP and the number of VIS housing units.

	Gen_2015	Gen_2016	Gen_2017	Gen_2018	Gen_2019	Gen_2020	Gen_2021
VIS_2015	0.59						
VIS_2016		0.29					
VIS_2017			0.20				
VIS_2018				0.27			
VIS_2019					0.26		
VIS_2020						0.28	
VIS_2021							0.86

0 (a. to g.), complements the previous table and allows us to observe the dispersion of the points representing the 33 departments in each of the 7 years under study. Graphically, there is no trend toward a linear behavior.

3.2. Correlation between GDP per capita and number of VIS housing units by department

We used the GDP per capita for a more in-depth analysis of the correlation between the general economic level and the number of VIS units. In this case, the direct relationship between general GDP and GDP per capita in the departments led to results similar to those of the previous section (Table 1).

The rho value for the Spearman correlation between overall GDP and GDP per capita for each department and for Colombia lies between 0.75 and 1.0, with an average value of 0.93 (Table A1).

3.3. Correlation between overall GDP and number of non-VIS housing units by department

The correlation between overall GDP and the number of non-VIS units for the entire country between 2015 and 2021 presents rho values above 0.88 for 86% of the years analyzed. This validates the correlation between higher economic growth and a higher number of high-cost housing units (non-VIS) (Table 3).

Table 3. Rho value for the correlation between general GDP and the number of No VIS housing units.

	Gen_2015	Gen_2016	Gen_2017	Gen_2018	Gen_2019	Gen_2020	Gen_2021
NoVIS_2015	0.64						
NoVIS_2016		0.94					
NoVIS_2017			0.90				
NoVIS_2018				0.88			
NoVIS_2019					0.88		
NoVIS_2020						0.89	
NoVIS_2021							0.91

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Unlike the analysis conducted for VIS housing, the relationship between the GDP of each department with non-VIS housing is presented in Figure 4 (a. to g.), complementing the information found in Table 2. The graphs show a greater linear trend in the data than the graphs for VIS units.

The rho correlation values for Figures 4 and 5 are in Tables 3 and 4.

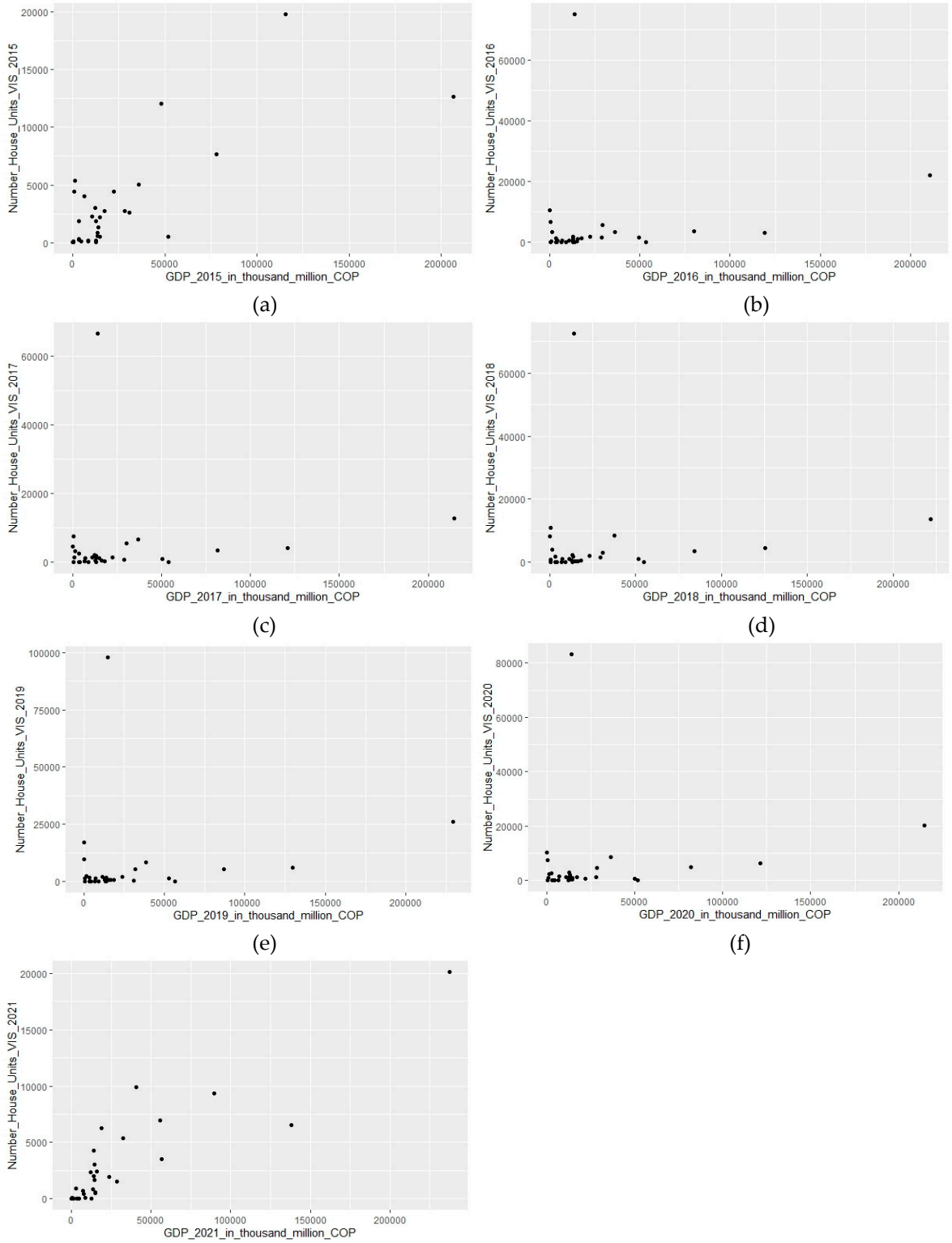

Figure 4. Colombia´s 33 departments number of house units VIS vs GDP, from (a) 2015; (b) 2016; (c) 2017; (d) 2018; (e) 2019; (f) 2020; and (g) 2021.

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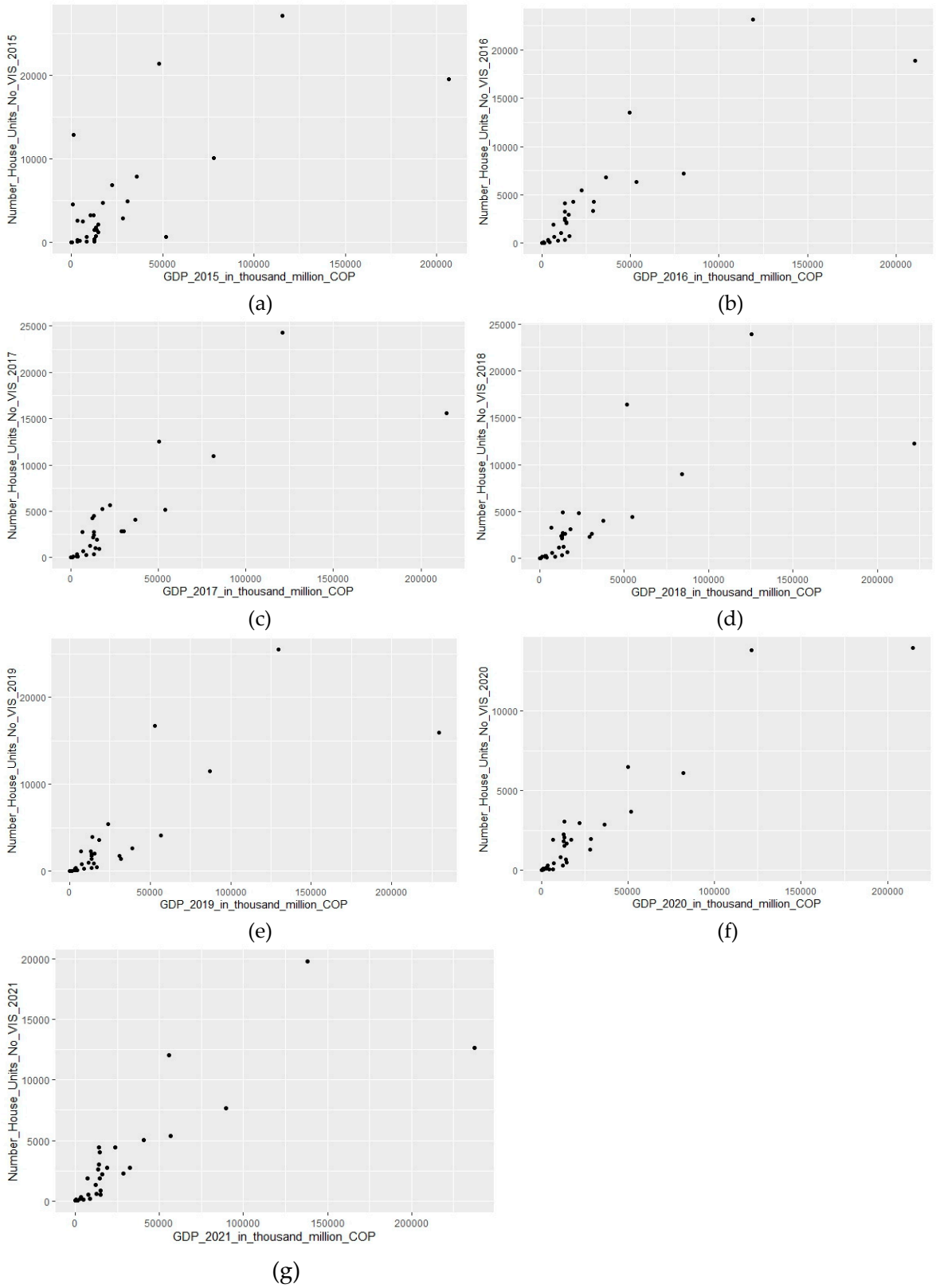

Figure 5. Colombia´s 33 departments number of house units No VIS vs GDP, from (a) 2015; (b) 2016; (c) 2017; (d) 2018; (e) 2019; (f) 2020; and (g) 2021.

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Table 4. Rho values for the correlation between the GDP of the manufacturing sector and the number of VIS housing units.

	Manuf_2015	Manuf_2016	Manuf_2017	Manuf_2018	Manuf_2019	Manuf_2020	Manuf_2021
VIS_2015	0.59						
VIS_2016		0.33					
VIS_2017			0.27				
VIS_2018				0.30			
VIS_2019					0.30		
VIS_2020						0.31	
VIS_2021							0.88

3.4. Correlation between the number of victims of internal displacement in Colombia and the number of VIS housing units by department

In this case, the number of internal displacement victims in Colombia was correlated for each of the 33 departments with the respective number of licensed VIS housing units per department, between 2018 and 2020.

Spearman's rho yielded values of -1.0 and 1.0 for 45% of the departments, 12% of which were negative values. Only 9% (3 out of 33) of the departments registered a null rho value, given that there was no VIS development in those regions. The other 54% of departments yielded a rho of -0.5 and 0.5, 21% of which were negative.

We can conclude from this that there is no correlation that could indicate that the departments with a greater number of migrant victims have had a greater increase in the number of VIS housing units.

As a further analysis, the Spearman and Pearson correlation coefficient was performed using the aggregate data of all 33 departments for the available years: 2018–2020. The results were rho = 0.5 and r = 0.02. These figures again suggest that it is not possible to establish a valid correlation between the number of licensed VIS housing units in the country and the number of forcibly displaced victims.

3.5. Correlation between the manufacturing industry's GDP and number of housing units by department

In this correlation, 71% of cases (2016–2020) presented positive rho values. However, they were lower than rho <0.33, meaning that there is no valid statistical correlation (Table 4).

An analysis of the manufacturing industry with the number of non-VIS units shows a significant difference from the previous case. Here, 86% of the cases (2016–2021) presented positive rho values (>0.91), which validates the hypothesis that there is a relationship between the increase in the economic production of the manufacturing industry and increased non-VIS housing units (Table 5).

Table 5. Rho values for the correlation between the GDP of the manufacturing sector and the number of No VIS housing units.

	Manuf_2015	Manuf_2016	Manuf_2017	Manuf_2018	Manuf_2019	Manuf_2020	Manuf_2021
NoVIS_2015	0.62						
NoVIS_2016		0.96					
NoVIS_2017			0.92				
NoVIS_2018				0.93			
NoVIS_2019					0.91		
NoVIS_2020						0.92	
NoVIS_2021							0.91

3.6. Correlation between the construction industry's GDP and number of housing units by department

Similar to the manufacturing industry, the years from 2016 to 2020 (83% of the records) present a positive but low correlation (rho <0.28), indicating that the correlation between the development of

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the construction industry and the number of VIS units is not statistically valid (Table 6). However, it is important to note that the year 2021 presents a valid correlation, with a rho value of 0.89.

Table 6. Rho values for the correlation between the GDP of the construction sector and the number of VIS housing units.

	Const_2015	Const_2016	Const_2017	Const_2018	Const_2019	Const_2020	Const_2021
VIS_2015	0.59						
VIS_2016		0.24					
VIS_2017			0.20				
VIS_2018				0.25			
VIS_2019					0.25		
VIS_2020						0.27	
VIS_2021							0.89

The correlation between the GDP of the construction industry and the number of non-VIS units is valid (rho >0.90) in 86% of cases (2016–2021). This positive correlation indicates that the stronger the economy in the construction industry, the more non-VIS units are built. It can also be interpreted to mean that a greater number of constructed non-VIS units boosts the industry's economy. It should be pointed out that non-VIS housing has a higher commercial value than VIS housing, which explains why it provides more value to the industry's economy than VIS housing does (Table 7).

Table 7. Rho values for the correlation between the GDP of the construction sector and the number of No VIS housing units.

	Const_2015	Const_2016	Const_2017	Const_2018	Const_2019	Const_2020	Const_2021
NoVIS_2015	0.63						
NoVIS_2016		0.96					
NoVIS_2017			0.93				
NoVIS_2018				0.90			
NoVIS_2019					0.91		
NoVIS_2020						0.91	
NoVIS_2021							0.94

3.7. Correlation between the real estate industry's GDP and number of housing units by department

The correlation is low (rho <0.25) for 5 of the 6 years we analyzed (83%). Therefore, it can be inferred that the real estate industry has no impact on the development of VIS units (Table 8). However, as analyzed with the 2 preceding economic industries, the year 2021 presents a strong correlation with the number of VIS units (rho = 0.9).

Table 8. Rho values for the correlation between the GDP of the real state sector and the number of VIS housing units.

	Real_2015	Real_2016	Real_2017	Real_2018	Real_2019	Real_2020	Real_2021
VIS_2015	0.59						
VIS_2016		0.25					
VIS_2017			0.22				
VIS_2018				0.25			
VIS_2019					0.22		
VIS_2020						0.26	
VIS_2021							0.90

In addition, similar to the manufacturing and construction industries, there is a good correlation between the real estate industry and the number of units of high commercial value (non-VIS), with a trend toward values of rho >0.94 from 2016 onwards (Table 9).

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Table 9. Rho values for the correlation between the GDP of the real state sector and the number of No VIS housing units.

	Real_2015	Real_2016	Real_2017	Real_2018	Real_2019	Real_2020	Real_2021
NoVIS_2015	0.63						
NoVIS_2016		0.97					
NoVIS_2017			0.96				
NoVIS_2018				0.93			
NoVIS_2019					0.94		
NoVIS_2020						0.95	
NoVIS_2021							0.95

3.8. Correlation between the finance and insurance industry's GDP and number of housing units by department

Similar to the behavior of the real estate industry, the finance and insurance industry tends to correlate significantly with the development of higher-value housing units (non-VIS) (rho >0.92 in 86% of the data) (Table 10) and tends not to correlate with VIS social housing (rho <0.30 in 83% of cases). However, it must be noted that this correlation presented an increase (rho = 0.90) for the year 2021 (Table 11).

Table 10. Rho values for the correlation between the GDP of the financial sector and the number of No VIS housing units.

	Finan_2015	Finan_2016	Finan_2017	Finan_2018	Finan_2019	Finan_2020	Finan_2021
NoVIS_2015	0.62						
NoVIS_2016		0.97					
NoVIS_2017			0.95				
NoVIS_2018				0.92			
NoVIS_2019					0.92		
NoVIS_2020						0.93	
NoVIS_2021							0.95

Table 11. Rho values for the correlation between the GDP of the financial sector and the number of VIS housing units.

	Finan_2015	Finan_2016	Finan_2017	Finan_2018	Finan_2019	Finan_2020	Finan_2021
VIS_2015	0.57						
VIS_2016		0.30					
VIS_2017			0.24				
VIS_2018				0.28			
VIS_2019					0.26		
VIS_2020						0.30	
VIS_2021							0.90

3.9. Correlation between the mining industry's GDP and number of housing units by department

Unlike the previous economic industries (manufacturing, construction, real estate, and finance and insurance), the mining industry is mostly developed in rural areas, and its industry-specific GDP does not show a significant correlation with either VIS or non-VIS housing. In both cases, the rho values lie between -0.22 and 0.41 for the study years (Tables 12 and 13).

It is important to note that, although the correlations between 2016 and 2020 are not statistically valid (rho <0.22), they also turned out to be inverse (negative rho values).

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Table 12. Rho values for the correlation between the GDP of the mining sector and the number of VIS housing units.

	Min_2015	Min_2016	Min_2017	Min_2018	Min_2019	Min_2020	Min_2021
VIS_2015	0.06						
VIS_2016		-0.09					
VIS_2017			-0.22				
VIS_2018				-0.13			
VIS_2019					-0.16		
VIS_2020						-0.13	
VIS_2021							0.30

Table 13. Rho values for the correlation between the GDP of the mining sector and the number of No VIS housing units.

	Min_2015	Min_2016	Min_2017	Min_2018	Min_2019	Min_2020	Min_2021
NoVIS_2015	0.16						
NoVIS_2016		0.40					
NoVIS_2017			0.41				
NoVIS_2018				0.36			
NoVIS_2019					0.37		
NoVIS_2020						0.32	
NoVIS_2021							0.40

3.10. Correlation between the agricultural industry's GDP and number of housing units by department

There is no significant correlation between the agricultural industry (farming, livestock, forestry, and hunting and fishing) and the development of VIS units. The rho value lies between -0.04 and 0.37 in 86% of cases. However, as with other economic industries above, the correlation increases significantly in the year 2021, with a rho value of 0.55.

Importantly, although the correlations between 2016 and 2020 are not statistically valid (rho <0.13), they are also inverse (negative rho) (Table 14).

Table 14. Rho values for the correlation between the GDP of the agrobusiness sector and the number of VIS housing units.

	Agro_2015	Agro_2016	Agro_2017	Agro_2018	Agro_2019	Agro_2020	Agro_2021
VIS_2015	0.37						
VIS_2016		-0.04					
VIS_2017			-0.13				
VIS_2018				-0.09			
VIS_2019					-0.08		
VIS_2020						-0.05	
VIS_2021							0.55

On the other hand, the correlation with non-VIS housing units tends toward an acceptable correlation with rho values between 0.62 and 0.68 for the years 2016 to 2021, and 0.42 for 2015 (Table 15). In this case, the rho trend in 2021 is like the trend occurring from 2016 onwards.

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Table 15. Rho values for the correlation between the GDP of the agrobusiness sector and the number of No VIS housing units.

	Agro_2015	Agro_2016	Agro_2017	Agro_2018	Agro_2019	Agro_2020	Agro_2021
NoVIS_2015	0.42						
NoVIS_2016		0.68					
NoVIS_2017			0.68				
NoVIS_2018				0.64			
NoVIS_2019					0.68		
NoVIS_2020						0.62	
NoVIS_2021							0.67

The information from Tables 4 and 15 is summarized in Figures 6 and 7.

For the number of VIS Housing units (Figure 6), only the year 2015 data registers rho values that indicate good correlations with global GDP and sectoral GDP (rho>0.6), except for the mining sector. However, in 2021 the correlation was very strong with the global GDP and the GDP of the agrobusiness, manufacturing and real estate sectors. This may be due to the fact that it was the year of the start of economic recovery in the post-pandemic.

Based on the foregoing, it is concluded that the production of VIS housing in Colombia is not feasible to analyze historically, or project it over time, based on the behavior of the economic sectors.

On the contrary, the relationship between the number of Non-VIS housing units (Figure 7) and the behavior of the economic sectors is high (rho>0.6) in most years of analysis (2015 to 2020), except for the mining sector. But in 2021 the correlation it got worse for almost all economic sectors.

The foregoing concludes that the behavior of the Non-VIS housing market (more expensive) is linked to the main economic sectors behavior, but VIS social housing develops constantly, regardless of the situation of the main economic sectors. The year 2021 is for special analysis because it tends to change the tendency of previous years.

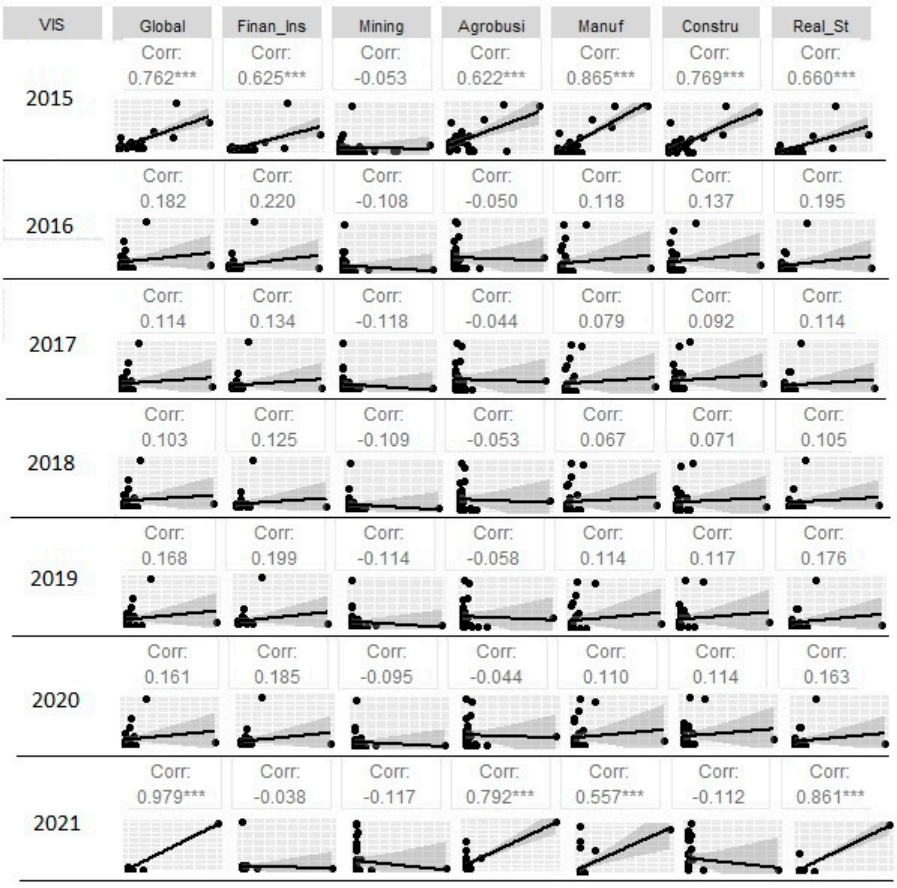

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Figure 6. Rho values for the correlation between the number of VIS housing units and global and economic sectors GDP. Years from 2015 to 2021.

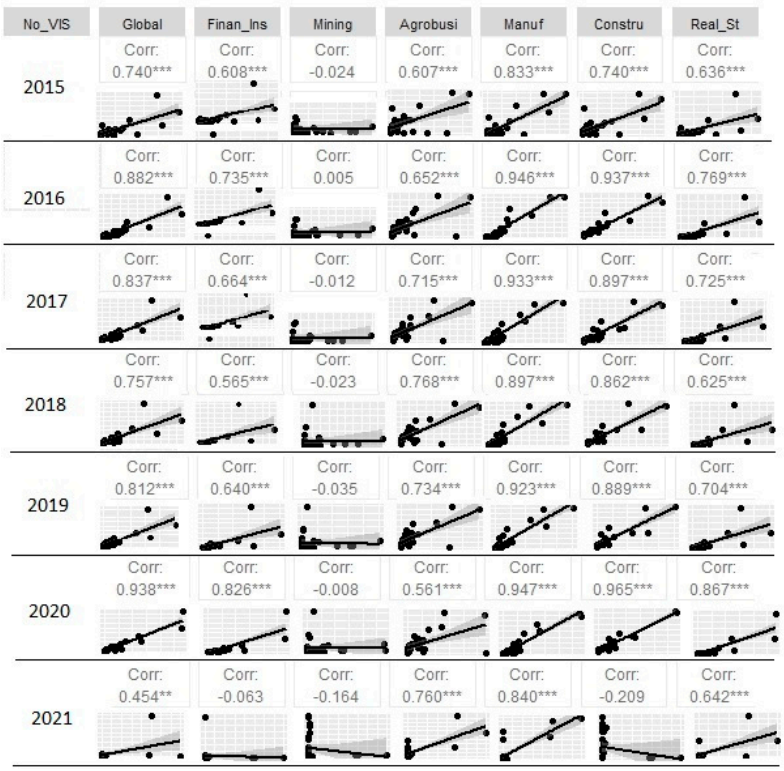

Figure 7. Rho values for the correlation between the number of No VIS housing units and global and economic sectors GDP. Years from 2015 to 2021.

4. Discussion

4.1. Low-income housing

Regarding our hypothesis, the growth of the number of low-income (VIS) housing units offer in Colombia's departments does not correlate with the overall economic development of each region (departmental GDP) in the 2016–2020 period. In 2015, the correlation was statistically acceptable (rho close to 0.60).

However, for 2021, the correlation is higher than in previous years (rho >0.80). This is because in 55% of the departments, the number of VIS units offer increased in 2021 compared to the average of previous years. In addition, Antioquia is the only region with a high economy that is included among the other 45% of departments that reduced their low-income housing units in 2021, with a reduction of only -10%. The other regions with the highest economies and VIS production in the country are Bogotá, Atlántico, Valle, Santander, and Cundinamarca, and they are all included in the group that did increase their number of VIS units in 2021.

Additionally, it can be seen that:

(a) the average percentage of the increase of VIS units between 2021 and the average of the previous years is 147%, while the difference is -72% for the departments that reduced their number of VIS in 2021.

(b) the standard deviation of the change in overall GDP in 2021 with respect to the average of previous years is 21%, and it is 164% for the number of VIS units.

The above explains that the increase in VIS units for 2021 was more significant than the decrease at the national level (in the corresponding departments). It also reveals that the considerable difference between the deviations of the 2 correlated variables means that one of them (general GDP) does not change significantly with respect to previous years, but the other (VIS) does, significantly modifying the rho value with respect to previous years.

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The overall increase of VIS units in Colombia in 2021 was mainly driven by the need to generate more social housing to help improve the social and economic conditions of many people who fell into poverty due to the consequences of COVID-19.

The previous paragraphs support the significant change in the rho value for 2021 throughout almost the entire study.

The analysis divided by economic industries showed a similar behavior to that of the general GDP. On analyzing the correlation of the number of VIS units with the industry-specific GDPs for manufacturing, construction, real estate, and finance and insurance, these industries tend to be more developed in urban areas than in rural areas, which may be related to the fact that most of the VIS housing units are built in urban areas.

In contrast, mining and agriculture tend to be rural industries. In this case, the correlation with the number of VIS units is lower, and there is a significant difference between the two. For the mining industry, the rho value in 2015 is 0.06 while for agriculture, it is 0.37.

In the 2016–2020 period, the behavior of the 2 industries is similar with negative rho values (unlike the first 4 economic industries we analyzed) and they are not greater than - 0.22. Although the values are too low to validate a statistical correlation, them being negative confirms an inverse relationship between the development of rural industries and a higher investment in VIS housing.

In 2021, there is a significant rho value increase for the 2 industries: 0.30 for mining and 0.55 for agriculture. The explanation for this improved correlation is explained above with the explanation for the increase in VIS units.

4.2. Non-VIS housing

Correlating the economy of the departments (overall GDP) with the number of non-VIS units shows an important shift. In this case, the rho value remains high from 2016 onwards, with a minimum of 0.88. For the year 2021, the rho value does not vary significantly with respect to the previous years; in fact, it is vastly similar (= 0.92).

The industry-specific GDP analysis for manufacturing, construction, real estate, and finance and insurance yields an acceptable correlation for 2015 (rho close to 0.60) and a very good correlation between 2016 and 2021 (rho >0.90).

For the other 2 industries (mining and agriculture) the correlations improve compared to the data for VIS housing. The rho value for the former is very low for 2015 (= 0.16), and it improves in the following years with values close to 0.40. For the latter industry, the correlation improves with values close to 0.65 between 2016 and 2021.

Once again, as with the VIS units, the correlation between industry-specific economic development and the number of non-VIS housing units is better in the industries that are more prevalent in the urban context than in the rural context.

In general, economic development, measured by GDP, either overall or with industry-specific data, shows a better correlation with the development of non-VIS housing units. This is because non-VIS housing units are the most built in Colombia in terms of units and saleable area. They are also the most economically profitable for the building construction industry, considering that they are not social housing and are more expensive.

5. Conclusions

The economic standing of the departments in Colombia, measured through the overall GDP for the 2015–2021 period, has a very good statistical correlation with the number of non-VIS units, which hold the highest commercial value.

Conducting a correlation analysis using the general GDP of each department as an economic indicator should have similar results if replaced by the GDP per capita, since the correlation between these two indicators is very high.

At the economic-specific level, this correlation is higher with activities that are mostly developed in an urban environment, such as manufacturing, construction, real estate, and finance and insurance.

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The correlation is lower with industries such as mining and agriculture, which mostly operate in rural areas.

Conversely, the correlation of economic performance over the same period with the number of VIS social housing units offered is not good, except for the year 2021, which shows a significant increase in the number of registered housing units compared to previous years.

The industry-specific analysis for VIS housing yields low correlations, but are especially dismissible for more rural industries, such as mining and agriculture.

Given their low correlation, the above confirm the hypothesis that more low-income housing units are offered in departments with a stronger economy, due to its low level of poverty and unmet basic needs UBN.

It is also clear that regions with better economies develop the non-VIS housing market more (high rho values), especially in those that have better numbers in urban economic sector like manufacturing, construction, real estate, and finance and insurance; and have less relationship in those regions where the economic development has been better in rural activities like mining and agriculture.

Finally, the behavior of the non-VIS housing market (more expensive) is linked to the main economic sectors, but VIS social housing develops constantly, regardless of the situation of the main economic sectors.

Appendix A

Table A1. Results of the normality test "Shapiro Wilk Test" to the variables studied.

Analisys Data	P-value	Normally distributed
Number_House Units_NoVIS_2015	3.31E-07	NO
Number_House Units_NoVIS_2016	2.52E-04	NO
Number_House Units_NoVIS_2017	2.57E-04	NO
Number_House Units_NoVIS_2018	8.88E-05	NO
Number_House Units_NoVIS_2019	2.52E-05	NO
Number_House Units_NoVIS_2020	7.55E-05	NO
Number_House Units_NoVIS_2021	5.02E-07	NO
Number_House Units_VIS_2015	5.02E-04	NO
Number_House Units_VIS_2016	5.29E-08	NO
Number_House Units_VIS_2017	4.01E-08	NO
Number_House Units_VIS_2018	5.05E-08	NO
Number_House Units_VIS_2019	6.12E-08	NO
Number_House Units_VIS_2020	5.30E-08	NO
Number_House Units_VIS_2021	4.35E-07	NO
Departmental_Manufacturing_GDP_2015	3.52E-05	NO
Departmental_Manufacturing_GDP_2016	3.87E-05	NO
Departmental_Manufacturing_GDP_2017	4.50E-05	NO
Departmental_Manufacturing_GDP_2018	4.73E-05	NO
Departmental_Manufacturing_GDP_2019	4.66E-05	NO
Departmental_Manufacturing_GDP_2020	5.70E-05	NO
Departmental_Manufacturing_GDP_2021	4.99E-08	NO
Departmental_Construction_GDP_2015	6.45E-04	NO
Departmental_Construction_GDP_2016	4.76E-04	NO
Departmental_Construction_GDP_2017	1.93E-04	NO
Departmental_Construction_GDP_2018	1.03E-04	NO
Departmental_Construction_GDP_2019	1.42E-04	NO
Departmental_Construction_GDP_2020	1.89E-07	NO

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Departmental_Construction_GDP_2021	1.39E-07	NO
Departmental_Real_State_GDP_2015	2.53E-07	NO
Departmental_Real_State_GDP_2016	2.69E-07	NO
Departmental_Real_State_GDP_2017	2.81E-07	NO
Departmental_Real_State_GDP_2018	2.85E-07	NO
Departmental_Real_State_GDP_2019	2.91E-10	NO
Departmental_Real_State_GDP_2020	2.95E-07	NO
Departmental_Real_State_GDP_2021	3.11E-10	NO
Departmental_Financial_Insurance_GDP_2015	4.79E-08	NO
Departmental_Financial_Insurance_GDP_2016	4.71E-08	NO
Departmental_Financial_Insurance_GDP_2017	4.65E-08	NO
Departmental_Financial_Insurance_GDP_2018	4.70E-08	NO
Departmental_Financial_Insurance_GDP_2019	4.75E-08	NO
Departmental_Financial_Insurance_GDP_2020	4.74E-08	NO
Departmental_Financial_Insurance_GDP_2021	4.72E-11	NO
Departmental_Mining_GDP_2015	3.75E-06	NO
Departmental_Mining_GDP_2016	3.36E-06	NO
Departmental_Mining_GDP_2017	3.31E-09	NO
Departmental_Mining_GDP_2018	3.09E-06	NO
Departmental_Mining_GDP_2019	1.95E-06	NO
Departmental_Mining_GDP_2020	1.25E-09	NO
Departmental_Mining_GDP_2021	2.42E-09	NO
Departmental_Agrobusiness_GDP_2015	2.10E-02	NO
Departmental_Agrobusiness_GDP_2016	1.83E-02	NO
Departmental_Agrobusiness_GDP_2017	2.30E-02	NO
Departmental_Agrobusiness_GDP_2018	2.01E-02	NO
Departmental_Agrobusiness_GDP_2019	1.86E-02	NO
Departmental_Agrobusiness_GDP_2020	1.95E-02	NO
Departmental_Agrobusiness_GDP_2021	1.43E-05	NO
Departmental_Global_GDP_2015	1.24E-05	NO
Departmental_Global_GDP_2016	1.21E-05	NO
Departmental_Global_GDP_2017	1.18E-05	NO
Departmental_Global_GDP_2018	1.08E-05	NO
Departmental_Global_GDP_2019	1.06E-05	NO
Departmental_Global_GDP_2020	9.73E-06	NO
Departmental_Global_GDP_2021	9.13E-09	NO

Table A2. Spearman Test Rho value between GDP and GDP per capita (2015 to 2021).

Department	rho	Department	rho
COLOMBIA	0.9642857	GUAVIARE	1.0000000
AMAZONAS	0.9642857	HUILA	1.0000000
ANTIOQUIA	1.0000000	LA_GUAJIRA	0.9642857
ARAUCA	0.8928571	MAGDALENA	0.9642857
ATLANTICO	0.8928571	META	0.8928571
BOGOTA	0.9642857	NARINO	1.0000000
BOLIVAR	0.9642857	NORTE SANTANDER	0.8928571
BOYACA	1.0000000	PUTUMAYO	0.7857143
CALDAS	1.0000000	QUINDIO	1.0000000
CAQUETA	1.0000000	RISARALDA	1.0000000
CASANARE	0.8928571	SAN_ANDRES	0.9642857

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CAUCA	1.0000000	SANTANDER	0.9642857
CESAR	0.8928571	SUCRE	0.9642857
CHOCO	0.9642857	TOLIMA	1.0000000
CORDOBA	1.0000000	VALLE	1.0000000
CUNDINAMARCA	0.6071429	VAUPES	0.7500000
GUAINIA	0.7500000	VICHADA	1.0000000

Table A3. Number of licensed VIS house units, by department.

Department	# House Units VIS_2015	# House Units VIS_2016	# House Units VIS_2017	# House Units VIS_2018	# House Units VIS_2019	# House Units VIS_2020	# House Units VIS_2021
AMAZONAS	122	170	0	0	0	0	102
ANTIOQUIA	19755	3,252	4,129	4,407	6,141	6,241	6,564
ARAUCA	92	564	63	86	6	4	4
ATLANTICO	5,038	3,538	6,635	8,366	8,496	8,629	9,899
BOGOTA	12632	22147	12840	13600	26006	20161	20104
BOLIVAR	2,737	5,823	5,632	3,099	5,579	4,664	5,387
BOYACA	4,405	1,975	1,454	1,954	2,012	578	1,915
CALDAS	1,871	1,770	1,339	436	602	1,340	1,692
CAQUETA	301	6	1	107	11	0	0
CASANARE	623	25	33	233	50	14	29
CAUCA	2,210	458	1,156	316	782	893	2,398
CESAR	526	1,057	636	438	836	334	494
CHOCO	243	34	0	0	0	0	0
CORDOBA	896	74985	66561	72421	97729	83068	587
CUNDINAMARCA	12044	1,679	1,087	1,049	1,291	535	6,986
GUAINIA	75	6,818	7,567	10926	17010	7,488	
GUAVIARE	97	385	1,508	702	1,479	868	2
HUILA	4,460	0	0	0	200	239	2,042
LA_GUAJIRA	183	0	0	0	205	3	92
MAGDALENA	1,328	665	1,456	1,119	2,201	1,136	2,387
META	2,293	1,588	776	1,525	389	1,114	1,558
NARINO	2,643	1,077	2,031	472	687	3,049	874
NORTE SANTANDER	2,986	147	598	2,218	403	329	4,266
PUTUMAYO	200	1,416	2,539	1,813	1,854	2,677	909
QUINDIO	1,878	0	302	0	11	217	698
RISARALDA	4,000	737	1,865	1,901	1,893	1,965	3,013
SAN_ANDRES	45	3,433	3,225	4,041	2,340	2,380	
SANTANDER	5,393	0	0	0	0	0	3498
SUCRE	521	661	1,293	1,143	1,296	1,549	408
TOLIMA	2,757	1,343	238	564	726	1,151	6,286
VALLE	7,640	3,622	3,500	3,535	5,467	4,952	9,371
VAUPES	52	10595	4,576	8,335	9,754	10358	3
VICHADA	33	0	0	1	2	0	42

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Table A4. Number of licensed No VIS house units, by department.

Department	# House Units No_VIS_2015	# House Units No_VIS_2016	# House Units No_VIS_2017	# House Units No_VIS_2018	# House Units No_VIS_2019	# House Units No_VIS_2020	# House Units No_VIS_2021
AMAZONAS	40	65	19	14	29	55	122
ANTIOQUIA	27074	23120	24251	23875	25446	13829	19755
ARAUCA	194	140	105	118	117	51	92
ATLANTICO	7,869	6,795	4,069	3,999	2,674	2,858	5,038
BOGOTA	19512	18857	15562	12281	15969	13946	12632
BOLIVAR	2,867	4,289	2,856	2,624	1,391	1,987	2,737
BOYACA	6,887	5,474	5,665	4,814	5,436	2,964	4,405
CALDAS	1,553	2,415	2,461	2,757	1,788	2,085	1,871
CAQUETA	293	353	334	253	363	298	301
CASANARE	747	381	401	342	414	322	623
CAUCA	2,149	2,920	1,935	2,658	2,002	1,698	2,210
CESAR	1,218	740	951	678	501	511	526
CHOCO	154	155	136	193	121	120	243
CORDOBA	1,792	2,059	1,058	1,261	876	704	896
CUNDINAMARCA	21347	13532	12573	16409	16734	6,497	12044
GUAINIA	14	27	48	34	35	38	75
GUAVIARE	155	95	56	15	21	93	97
HUILA	4,524	2,150	2,797	2,162	1,451	1,567	4,460
LA_GUAJIRA	689	244	248	188	275	82	183
MAGDALENA	1,505	1,083	1,262	1,210	997	824	1,328
META	3,291	3,311	2,841	2,293	1,789	1,327	2,293
NARINO	4,973	3,230	4,294	2,369	2,329	2,254	2,643
NORTE SANTANDER	3,302	2,547	2,221	2,358	2,007	1,813	2,986
PUTUMAYO	447	300	170	276	292	176	200
QUINDIO	2,581	1,900	2,804	3,270	2,320	1,934	1,878
RISARALDA	2,562	4,159	4,499	4,954	3,974	3,048	4,000
SAN_ANDRES	93	61	117	178	55	53	45
SANTANDER	12897	6,314	5,168	4,398	4,096	3,705	5,393
SUCRE	683	694	668	635	842	429	521
TOLIMA	4,789	4,264	5,283	3,102	3,636	1,911	2,757
VALLE	10113	7,228	10971	8,986	11543	6,135	7,640
VAUPES	15	31	23	30	32	29	52
VICHADA	8	7	11	6	8	5	33

Table A5. Total GDP in thousands of million COP, by department.

Department	Total_GDP_2015	Total_GDP_2016	Total_GDP_2017	Total_GDP_2018	Total_GDP_2019	Total_GDP_2020	Total_GDP_2021
AMAZONAS	593	614	630	648	666	615	677
ANTIOQUIA	115446	119046	120973	125173	129672	121300	137977
ARAUCA	4,534	4,272	4,168	4,293	4,596	4,565	4,757
ATLANTICO	35716	36347	36779	37610	38690	36173	40643
BOGOTA	206478	210683	214484	221652	229314	214485	237244
BOLIVAR	28105	29285	30271	30804	31920	28623	32610

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BOYACA	22165	22341	22574	23237	23732	21709	23518
CALDAS	12514	12821	13043	13395	13798	13174	14604
CAQUETA	3,350	3,427	3,454	3,525	3,596	3,387	3,634
CASANARE	13305	12938	12960	13291	13493	12245	12396
CAUCA	14622	14975	14876	15139	15614	14630	16019
CESAR	14570	15676	16123	16090	16646	14256	14828
CHOCO	3,571	3,765	3,482	3,202	3,341	3,264	3,508
CORDOBA	13657	13731	13920	14196	14774	13915	15269
CUNDINAMARCA	48055	49601	50409	51551	52890	49779	55575
GUAINIA	307	307	304	313	322	293	334
GUAVIARE	8,666	676	692	693	715	683	742
HUILA	677	13636	13212	13369	13754	13144	14221
LA_GUAJIRA	8,666	8,891	8,996	8,977	8,955	6,684	8,857
MAGDALENA	13805	10869	10990	11248	11525	10832	12112
META	10514	28904	29022	29404	30800	28105	28788
NARINO	30712	12760	12441	12643	13064	12501	13698
NORTE SANTANDER	12230	13041	12940	13347	13550	12804	14157
PUTUMAYO	12534	3,450	3,386	3,393	3,284	2,830	3,080
QUINDIO	3,481	6,624	6,736	6,793	6,968	6,550	7,338
RISARALDA	6,381	13027	13202	13551	13969	13185	14649
SAN_ANDRES	12656	1,305	1,343	1,373	1,416	1,139	1,442
SANTANDER	1,253	53175	54065	54942	56515	51681	56567
SUCRE	51999	6,807	6,982	7,108	7,366	6,928	7,667
TOLIMA	17381	17708	17936	18120	18512	17237	18828
VALLE	78074	80022	81447	84172	87023	81835	89872
VAUPES	233	236	239	248	257	237	258
VICHADA	529	529	541	556	581	554	600

Table A6. Agrobusiness sector GDP in thousands of million COP, by department.

Department	Agrobusiness_2015	Agrobusiness_2016	Agrobusiness_2017	Agrobusiness_2018	Agrobusiness_2019	Agrobusiness_2020	Agrobusiness_2021
AMAZONAS	96	94	98	102	104	113	114
ANTIOQUIA	6,153	6,363	6,567	6,678	6,897	7,024	7,459
ARAUCA	748	767	840	866	885	902	957
ATLANTICO	330	353	375	392	405	411	436
BOGOTA	12	12	13	13	13	13	13
BOLIVAR	1,196	1,218	1,280	1,335	1,374	1,449	1,469
BOYACA	2,143	2,186	2,405	2,449	2,528	2,571	2,574
CALDAS	1,274	1,211	1,262	1,281	1,311	1,328	1,305
CAQUETA	460	498	509	504	526	541	533

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CASANARE	1,220	1,427	1,525	1,528	1,555	1,583	1,686
CAUCA	1,693	1,766	1,852	1,826	1,884	1,903	1,997
CESAR	1,256	1,169	1,243	1,276	1,326	1,343	1,376
CHOCO	582	619	651	637	668	687	707
CORDOBA	1,543	1,478	1,496	1,529	1,557	1,595	1,613
CUNDINAMARCA	6,300	6,592	7,112	7,277	7,471	7,594	7,896
GUAINIA	25	26	29	30	30	32	32
GUAVIARE	326	140	144	146	147	149	157
HUILA	129	2,266	2,275	2,319	2,368	2,439	2,441
LA_GUAJIRA	326	332	374	375	387	391	392
MAGDALENA	2,112	1,591	1,706	1,706	1,744	1,744	1,746
META	1,576	2,464	3,050	3,053	3,123	3,185	3,431
NARINO	2,361	1,730	1,841	1,887	1,916	2,006	2,013
NORTE SANTANDER	1,767	1,220	1,248	1,271	1,299	1,323	1,330
PUTUMAYO	1,199	191	181	186	187	192	197
QUINDIO	191	973	1,017	1,027	1,056	1,057	1,121
RISARALDA	934	828	839	849	887	898	925
SAN_ANDRES	845	15	14	15	15	17	17
SANTANDER	15	3,928	4,191	4,301	4,452	4,471	4,557
SUCRE	3,793	656	695	694	702	729	752
TOLIMA	2,737	2,744	2,776	2,734	2,783	2,840	2,937
VALLE	4,329	4,394	4,416	4,558	4,674	4,856	4,913
VAUPES	17	18	18	19	19	19	18
VICHADA	172	173	173	177	182	186	192

Table A7. Mining sector GDP in thousands of million COP, by department.

Department	Mining_2015	Mining_2016	Mining_2017	Mining_2018	Mining_2019	Mining_2020	Mining_2021
AMAZONAS	1	1	1	1	1	1	1
ANTIOQUIA	2,430	2,593	2,187	2,200	2,188	2,611	2,960
ARAUCA	1,704	1,530	1,404	1,509	1,691	1,724	1,677
ATLANTICO	96	102	105	105	113	92	99
BOGOTA	322	338	333	334	333	222	221
BOLIVAR	677	731	709	723	821	721	771
BOYACA	2,109	1,962	1,812	1,784	1,661	1,432	1,158
CALDAS	141	192	188	165	165	205	205
CAQUETA	16	16	14	14	13	11	11
CASANARE	6,351	5,981	5,974	6,177	6,177	5,263	4,865
CAUCA	392	320	228	166	167	120	123
CESAR	4,985	6,177	6,380	6,113	6,338	4,579	4,113
CHOCO	913	967	654	334	370	429	428

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CORDOBA	201	225	220	237	298	353	334
CUNDINAMARCA	489	481	477	447	395	292	234
GUAINIA	33	29	22	19	21	12	22
GUAVIARE	3,639	2	2	2	2	2	2
HUILA	3	906	844	835	824	790	760
LA_GUAJIRA	3,639	3,585	3,418	3,325	3,166	1,424	2,853
MAGDALENA	1,015	43	40	38	38	31	36
META	39	14824	13976	13955	14888	13226	12377
NARINO	16456	645	226	120	119	77	77
NORTE SANTANDER	486	401	390	395	326	294	197
PUTUMAYO	395	1,190	1,183	1,097	957	653	694
QUINDIO	1,366	25	25	24	24	16	17
RISARALDA	27	52	47	46	46	45	43
SAN_ANDRES	45	1	1	1	1	1	1
SANTANDER	1	2,145	2,166	2,341	2,232	1,866	1,780
SUCRE	2,367	42	47	47	48	47	46
TOLIMA	720	593	656	597	596	537	491
VALLE	160	151	128	132	141	92	109
VAUPES	1	1	1	1	1	1	1
VICHADA	2	2	2	2	2	1	1

Table A8. Financial and insurance sector GDP in thousands of million COP, by department.

Department	Financial_Insurance_2015	Financial_Insurance_2016	Financial_Insurance_2017	Financial_Insurance_2018	Financial_Insurance_2019	Financial_Insurance_2020	Financial_Insurance_2021
AMAZONAS	15	15	15	15	16	16	17
ANTIOQUIA	5,517	5,687	5,992	6,237	6,660	6,828	7,171
ARAUCA	61	60	60	60	63	64	66
ATLANTICO	1,469	1,500	1,579	1,647	1,753	1,791	1,817
BOGOTA	17123	17717	18722	19404	20600	21070	21794
BOLIVAR	648	669	702	722	765	782	805
BOYACA	401	411	430	448	475	485	502
CALDAS	388	397	417	433	455	466	482
CAQUETA	84	86	90	93	99	101	104
CASANARE	175	165	173	178	188	191	196
CAUCA	259	252	263	270	286	292	301
CESAR	256	264	277	287	303	310	318
CHOCO	61	63	66	67	72	73	75
CORDOBA	338	322	322	325	347	355	367
CUNDINAMARCA	582	602	632	652	694	710	735
GUAINIA	6	6	6	6	7	7	7
GUAVIARE	138	13	13	14	15	15	16
HUILA	14	364	383	397	420	430	444

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LA_GUAJIRA	138	134	140	144	151	154	161
MAGDALENA	355	281	295	305	323	329	338
META	273	434	454	469	493	501	513
NARINO	425	351	370	385	407	417	429
NORTE SANTANDER	342	379	398	412	438	448	463
PUTUMAYO	371	53	55	57	61	62	64
QUINDIO	52	190	200	208	222	227	235
RISARALDA	186	457	478	495	522	533	550
SAN_ANDRES	445	35	37	38	40	41	42
SANTANDER	34	1,237	1,303	1,360	1,443	1,470	1,516
SUCRE	1,200	164	172	179	189	194	199
TOLIMA	454	464	484	501	529	541	557
VALLE	2,853	2,945	3,112	3,236	3,456	3,523	3,599
VAUPES	3	2	3	3	3	3	3
VICHADA	11	10	9	9	10	10	11

Table A9. Real state sector GDP in thousands of million COP, by department.

Department	Real_State_2015	Real_State_2016	Real_State_2017	Real_State_2018	Real_State_2019	Real_State_2020	Real_State_2021
AMAZONAS	12	25	24	24	25	25	26
ANTIOQUIA	19967	11790	10578	11097	11613	11790	12287
ARAUCA	134	167	154	159	164	167	173
ATLANTICO	5,916	2,887	2,620	2,732	2,830	2,887	2,950
BOGOTA	19243	31480	29022	30138	31047	31480	32062
BOLIVAR	4,688	2,134	1,951	2,027	2,092	2,134	2,169
BOYACA	2,819	1,403	1,265	1,322	1,375	1,403	1,458
CALDAS	1,767	956	879	910	941	956	975
CAQUETA	98	276	255	265	273	276	281
CASANARE	318	383	356	370	379	383	396
CAUCA	2,618	791	721	753	777	791	809
CESAR	562	836	767	795	821	836	848
CHOCO	31	78	73	76	78	78	80
CORDOBA	1,422	527	493	510	523	527	539
CUNDINAMARCA	10815	2,523	2,242	2,359	2,473	2,523	2,615
GUAINIA	8	10	9	10	10	10	10
GUAVIARE	12	34	32	33	34	34	36
HUILA	484	840	781	810	829	840	859
LA_GUAJIRA	53	397	364	379	391	397	406
MAGDALENA	458	746	685	711	736	746	764
META	672	971	902	933	960	971	1,003
NARINO	355	1,125	1,030	1,074	1,110	1,125	1,153
NORTE SANTANDER	841	1,326	1,226	1,270	1,311	1,326	1,354
PUTUMAYO	29	158	148	153	156	158	160
QUINDIO	341	804	736	765	794	804	822
RISARALDA	1,819	1,047	966	1,003	1,035	1,047	1,071

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SAN_ANDRES	16	63	63	65	67	63	64
SANTANDER	9,535	4,420	4,133	4,257	4,346	4,420	4,545
SUCRE	587	414	389	400	409	414	422
TOLIMA	1,890	1,151	1,059	1,099	1,133	1,151	1,176
VALLE	13646	11353	10545	10922	11200	11353	11661
VAUPES	0	10	10	10	10	10	10
VICHADA	4	25	23	24	25	25	26

Table A10. Construction sector GDP in thousands of million COP, by department.

Department	Construction _2015	Construction _2016	Construction _2017	Construction _2018	Construction _2019	Construction _2020	Construction _2021
AMAZONAS	12	21	23	24	24	25	25
ANTIOQUIA	20435	9,933	10296	10578	11097	11613	8,566
ARAUCA	141	146	150	154	159	164	164
ATLANTICO	6,128	2,483	2,539	2,620	2,732	2,830	1,828
BOGOTA	20069	27584	28334	29022	30138	31047	6,832
BOLIVAR	4,530	1,820	1,885	1,951	2,027	2,092	2,432
BOYACA	2,954	1,183	1,225	1,265	1,322	1,375	1,874
CALDAS	1,717	843	868	879	910	941	768
CAQUETA	98	240	249	255	265	273	290
CASANARE	307	339	349	356	370	379	326
CAUCA	2,644	661	692	721	753	777	1,044
CESAR	556	731	747	767	795	821	689
CHOCO	32	66	68	73	76	78	131
CORDOBA	1,377	468	483	493	510	523	687
CUNDINAMARCA	11017	2,002	2,129	2,242	2,359	2,473	2,454
GUAINIA	8	9	9	9	10	10	40
GUAVIARE	12	348	30	32	33	34	44
HUILA	483	30	760	781	810	829	1,054
LA_GUAJIRA	55	348	356	364	379	391	601
MAGDALENA	468	717	682	685	711	736	633
META	638	667	873	902	933	960	1,019
NARINO	354	843	1,008	1,030	1,074	1,110	915
NORTE SANTANDER	864	983	1,211	1,226	1,270	1,311	1,173
PUTUMAYO	30	1,119	144	148	153	156	218
QUINDIO	349	141	700	736	765	794	428
RISARALDA	1,811	666	923	966	1,003	1,035	669
SAN_ANDRES	17	860	61	63	65	67	29
SANTANDER	9,276	59	4,013	4,133	4,257	4,346	3,198
SUCRE	617	3,853	381	389	400	409	599
TOLIMA	1,989	978	1,019	1,059	1,099	1,133	1,233
VALLE	14011	9,630	10049	10545	10922	11200	3,249
VAUPES	0	9	10	10	10	10	20
VICHADA	4	22	23	23	24	25	47

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Table A11. Manufacturing sector GDP in thousands of million COP, by department.

Department	Manufacturing_2015	Manufacturing_2016	Manufacturing_2017	Manufacturing_2018	Manufacturing_2019	Manufacturing_2020	Manufacturing_2021
AMAZONAS	11	34	38	37	34	25	12
ANTIOQUIA	19853	9,041	9,677	10346	10189	7,212	21810
ARAUCA	134	316	224	175	191	159	140
ATLANTICO	5,992	2,951	3,127	2,812	2,426	1,722	6,613
BOGOTA	19680	10576	10855	10873	9,729	6,970	20226
BOLIVAR	4,274	3,360	3,531	3,173	3,291	2,385	5,198
BOYACA	2,981	2,335	2,403	2,580	2,544	1,912	3,086
CALDAS	1,639	966	925	944	902	710	1,977
CAQUETA	99	449	407	397	346	286	104
CASANARE	298	537	395	404	410	316	369
CAUCA	2,642	1,442	1,252	1,308	1,340	1,016	2,691
CESAR	563	751	674	700	705	585	627
CHOCO	31	210	187	183	171	128	33
CORDOBA	1,341	1,168	1,077	943	975	707	1,555
CUNDINAMARCA	10680	4,118	3,947	3,831	3,539	2,516	11815
GUAINIA	7	46	44	48	46	35	9
GUAVIARE	53	76	78	57	55	49	12
HUILA	12	1,741	1,280	1,167	1,162	930	534
LA_GUAJIRA	53	644	739	676	661	541	58
MAGDALENA	485	1,066	867	826	738	548	527
META	464	1,628	1,375	1,458	1,410	1,025	755
NARINO	652	1,336	1,159	1,147	1,154	932	384
NORTE SANTANDER	355	1,598	1,323	1,407	1,248	1,011	881
PUTUMAYO	860	301	242	263	233	197	32
QUINDIO	30	744	717	620	569	398	374
RISARALDA	336	952	890	897	881	698	2,005
SAN_ANDRES	1,723	44	43	39	38	30	18
SANTANDER	16	6,027	5,593	4,822	4,914	3,338	10028
SUCRE	8,327	688	693	685	729	605	614
TOLIMA	1,897	1,505	1,582	1,533	1,485	1,132	1,872
VALLE	13729	3,394	3,581	3,899	3,804	2,729	14710
VAUPES	0	27	26	28	28	20	0
VICHADA	4	52	58	58	63	47	4

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