The effect of inequality and economic activity on COVID-19 transmission in Ecuador: An outline of its possible economic, social, and demographic determinants

Efecto de la desigualdad y la actividad económica en el COVID-19 en Ecuador: un bosquejo de sus posibles determinantes económicos, sociales y demográficos

Pablo Ponce[1], Verónica Loaiza[2], María de la Cruz del Rio-Rama[3*], Leticia Bollain-Parra[4]

[1]Carrera de Economía, Universidad Nacional de Loja, Ecuador
[2]Carrera de Administración Pública, Universidad Nacional de Loja , Ecuador
[3]Departamento de Organización de Empresas y Marketing, Facultad de Ciencias Empresariales y Turismo, Universidad de Vigo, España
[4]Facultad de Contaduría y Ciencias Administrativas, Universidad Michoacana de San Nicolas de Hidalgo, México

Abstract

COVID-19 is a health problem that we are experiencing today which caused economic activity to decrease worldwide as a result of the confinement decreed in the countries. COVID-19 is influenced by economic factors that affect the spread of infections and vary depending on the structural characteristics of the countries. In this sense, the objective of this research work is to examine the effect of income inequality and economic activity on COVID-19 infections in Ecuador. Then economic, social and demographic variables are used to determine other factors associated with the increase in infections. To meet the objective, the methodology used is based on the use of econometric techniques (linear regression model with Ordinary Least Squares estimator) with cross-sectional data collected from the National Survey of Employment, Unemployment and Underemployment (2019) and the Ministry of Public Health (2020). The results obtained show that the increase in inequality causes increases in the contagion of COVID-19, in the same way the sectors of economic activity cause a heterogeneous effect on COVID-19. Policy

[*]Corresponding author.

E-mail address: delrio@uvigo.es (M de la C. del Rio-Rama).

Peer Review under the responsibility of Universidad Nacional Autónoma de México.

measures should be aimed at guaranteeing access to goods and services for the most unequal groups to reduce COVID-19 infections.

Resumen

El COVID-19, es un problema sanitario que vivimos en la actualidad el cual provocó que la actividad económica a nivel mundial decrezca como consecuencia del confinamiento decretado en los países. El COVID-19 se ve influenciada por factores económicos que inciden en la propagación de los contagios y varían en función de las características estructurales de los países. En este sentido, el objetivo de este trabajo de investigación es examinar el efecto de la desigualdad de ingreso y la actividad económica en los contagios del COVID-19 en el Ecuador. Luego se utilizan variables económicas, sociales y demográficas para determinar otros factores asociados al aumento de los contagios. Para cumplir con el objetivo la metodología utilizada se basa en el uso de técnicas econométricas (modelo de regresión lineal con el estimador Mínimos Cuadrados Ordinarios) con datos de corte transversal recopilados de la Encuesta Nacional de Empleo, Desempleo y Subempleo (2019) y del Ministerio de Salud Pública (2020). Los resultados obtenidos muestran que el aumento de la desigualdad provoca aumentos del contagio del COVID-19, de igual manera los sectores de la actividad económica provocan un efecto heterogéneo en el COVID-19. Las medias de política deben estar orientadas a garantizar el acceso a bienes y servicios de los grupos con mayor desigualdad para disminuir los contagios del COVID-19.

Introduction

SARS-CoV-2, more commonly known as COVID-19, is the cause of the current pandemic that has affected every country in the world. It has caused a health emergency leading to an economic crisis due to the paralysis of productive activities stemming from the lockdowns imposed by governments to try to control contagion. However, the effects of this type of measure are reflected in the carrying out of society's daily activities. This situation has spilled over and has affected all countries, regardless of their economic, social, cultural, or geographic conditions, and has affected to a greater extent those countries with large social gaps, such as developing countries (Bukari et al., 2020).

According to the Economic Commission for Latin America and the Caribbean (ECLAC, 2020), Latin America registered slow economic growth long before the pandemic, and this region of the world has regressed ten years. That is, the pandemic caused it to register a Gross Domestic Product (GDP) per capita similar to that of 2010. Latin America became one of the regions most affected worldwide by the

pandemic, which caused an economic contraction of 9.1%, reflected in an increase in unemployment of 13.5% and in poverty of 37.5%, making it one of the worst crises in the last 100 years.

In this situation, most countries in the region have been strongly affected due to poverty and inequality, according to the World Health Organization (WHO, 2020). One of the most affected countries is Ecuador, which has recorded alarming figures caused by the COVID-19 pandemic. Currently, the number of people infected by COVID-19 exceeds 110,000, and the number of deaths is almost 7,000, according to official statistics provided by the Ministry of Public Health of Ecuador (MSP, 2020). This situation led to the paralysis of economic activities due to the lockdown that began last March and caused a slowdown in economic activity. As a result, several companies closed because they did not have enough income to cover production costs, which in turn led to an increase in unemployment, poverty, and inequality (Instituto Nacional de Estadísticas y Censos, INEC 2020).

It is worth mentioning that, although COVID-19 has accentuated social and economic problems in the country, these were also some of the main determinants of the number of infections (Suryahadi et al., 2020). Therefore, following Ahamed et al. (2020), this research alludes to the fact that income inequality generates a higher probability of an increase in COVID-19 contagion cases. Thus, the main objective of this research is to examine the effect of inequality and economic activity, sectorized according to its branches of activity, on COVID-19 infections in Ecuador. Subsequently, a series of covariates is included that captures the economic, social, and demographic effects, such as formal sector, primary sector, secondary sector, tertiary sector, urban population, age, and female population.

The analysis considered 193 cantons with available information belonging to the 24 provinces of Ecuador. Cross-sectional data from the National Survey of Employment, Unemployment, and Underemployment (ENEMDU, 2019) compiled by INEC are used to develop the research objective. Data on COVID-19 cases were taken from information published by the MSP (2020). Therefore, the data are processed using quantitative methods, specifically Ordinary Least Squares (OLS), methods frequently used to analyze social phenomena. The estimates presented problems of heteroscedasticity, which were corrected by the inclusion of robust variances. Thus, the research supports the hypothesis that inequality is a determining factor in increasing COVID-19 cases in Ecuador. Furthermore, according to a thorough review of the literature, there are currently no studies that analyze the determinants of COVID-19 in Ecuador using quantitative methods. Therefore, this study is one of the first to be carried out on this subject in Ecuador and is an unprecedented contribution to the academic and scientific community.

This research is structured in four sections in addition to the introduction. The second section contains a brief review of previous literature. The third section describes the data and methodology used. The fourth section discusses the results found, and the fifth section contains the conclusions of the research and possible public policy implications.

Literature review

In December 2019, in the Wuhan province of China, there was an outbreak of SARS-CoV-2, and according to data from the World Bank (2020), it is estimated that COVID-19 will leave about 71 million people in extreme poverty, which will aggravate the economic situation of the different countries affected by this virus. Thus, several scientific studies have been carried out on the possible causes and consequences of increased COVID-19 infections worldwide and in various branches of knowledge. However, the available information is limited, and few studies have used inequality as an explanatory variable for COVID-19, which is understandable given that the situation started recently and is still ongoing. Therefore, this section reviews the major academic studies carried out in this regard, not as determinants of COVID-19 but rather as causes of COVID-19.

In this context, in China, Lau et al. (2020) analyzed the available data, both nationally and internationally, to assess whether the air transport blockade imposed on the Wuhan province was effective. They found a significant correlation between air traffic and the spread of the virus, which weakened after the aforementioned air-transport blockade. Lipsitch et al. (2020) mention that another aspect that boosted the increase in infections and deaths in Wuhan was age; the older a person, the greater the probability of infection with COVID-19. Ahamed et al. (2020) made estimates using 78 low and lower-middle-income countries at the global level. They explain that income inequality is a significant variable in explaining COVID-19 infections, and they also mention that financial inclusion is a key factor in reducing poverty caused by the pandemic. In Guatemala, Ruiz (2020) emphasizes that developing and less developed countries are more vulnerable to the crisis triggered by COVID-19. The results indicate that, like inflation, the pandemic accentuated poverty and mass unemployment. In Brazil, Santos et al. (2020) use the Kaplan-Meier method and determine that the survival of patients admitted to health centers after contracting the virus is associated with social and demographic factors, such as age, race, illiteracy, and the condition of belonging to the vulnerable care group.

On the other hand, referring to the externalities generated by COVID-19 at the economic and social level, authors such as Suryahadi et al. (2020) estimate the impact of COVID-19 on poverty in Indonesia. They found that the poverty rate will increase to 9.7% by the end of 2020 and recommend expanding social protection programs for the new population. Likewise, in Ghana, West Africa, 48 deaths and 11,000 positive cases had already been recorded. Before this, Bukari et al. (2020) conducted a study that makes it possible to identify the threats caused by COVID-19 to the fulfillment of the Sustainable Development Goals, i.e., eradicating poverty and hunger. They use Ordinary Least Squares, the probit model, and regressions to identify that the COVID-19 pandemic increased household poverty and worsened the population's living conditions. The inhabitants in rural areas are the most affected.

Furthermore, there is statistical significance between the COVID-19 period and water-related problems. Laborde et al. (2020) assert that as long as social protection programs provide financial stability to people, at least to supply their food, especially in developing countries, the government must guarantee them so that poverty does not increase.

For their part, Saunders and Evans (2020) predict a loss of income of 220 billion dollars in developing countries. These countries have limited access to social protection, and food security is not the best. These authors also make comparisons with tuberculosis, which was one of the most lethal diseases until April 1, 2020. At the time of writing, COVID-19 has surpassed it. Another of the most affected countries is Pakistan, where Mamun and Ullah (2020) investigated, emphasizing the increase in suicides due to the increase in poverty. At first, suicides for fear of becoming infected were recorded, but in a second instance, suicides were linked to the poverty caused by the COVID-19 pandemic. Thakur and Jain (2020) mention that isolation or social distancing in Pakistan creates anxiety in many people, especially the elderly, and becomes the main concern of those who do not have sufficient income to cover their basic needs, which later becomes a factor that increases poverty.

The pandemic spread from China to Europe and then to the United States. Laborde et al. (2020) state that the most affected countries are those with medium or low incomes, and in many of these countries, the health system has already collapsed. They also emphasize that the quarantine caused the closure of millions of businesses. Consequently, 140 million people could be considered part of the population living in extreme poverty. Likewise, Valensisi (2020) presents results that project that the number of people in extreme poverty could increase to 68 million people. Along the same lines, Atalan (2020) conducts research collecting data from 49 countries and using a correlation test between effective cases of COVID-19 and the lockdowns imposed by the different selected countries. They find that the measures imposed by governments, such as social isolation, effectively contain the increase of COVID-19 cases, but also ensure incalculable economic losses.

In India, Kanitkar (2020), using a linear Input-Output (IO) model to estimate the economic losses due to COVID-19, finds that the duration of the lockdown (isolation) is a determining factor and predicts a loss of GDP of between 10% and 31%. He also mentions that the energy supply has decreased by 26% during the lockdown, reducing CO_2 emissions. Also in India, Singh (2020) conducted a study that provides information on the situation of migrants in the short and long term. They indicate that there are incentives to curb the crisis. The biggest challenge will be to effectively implement state plans to improve the situation without the interference of corruption.

On the other hand, Noorbhai (2020) proposes a mathematical model to estimate a reactivation of the economy and mentions the factors that should be considered to implement the model proposed, such as health capacity, number of hospitals, population size, and accuracy in the number of registered

cases. Fernandes (2020), using data from 30 countries in different circumstances, concludes that countries highly dependent on foreign trade will be the most affected, followed by countries such as Greece, Portugal, and Spain, which are dependent on tourism and are also severely affected. The author concludes by stating that the loss represents between 2.5% and 3% of GDP globally for each additional month of the health crisis.

In general terms, COVID-19 causes a health crisis and an economic crisis that affects the entire population, especially people with lower incomes. Income inequality, especially in developing countries, is one of the problems that causes the most vulnerable population to become part of the population living in poverty and extreme poverty. Many of the authors cited in this section agree that countries must strengthen their social protection programs to prevent an increase in populations living in poverty. Timmermann (2020) mentions that, within an unequal population, it is important to include the poorest population to identify the weak points of health and food security with the appropriate design of public policies that protect the most vulnerable population. However, it is important to consider the findings of Bryce et al. (2020), who mention that the impact of poverty and malnutrition is highlighted in the media, which leads them to conclude that behavioral economics is a key factor to consider when individuals face a crisis since it reduces the focus on long-term solutions.

In the case of Ecuador, the literature is scarce, so this research seeks to contribute to the academic field to provide input for the debate on the topic in question.

Data and methodology

Statistical sources

A series of economic, social, and demographic variables at the cantonal level in Ecuador was obtained from official sources to examine the determinants of COVID-19 in Ecuador. According to the availability of information, data from 193 cantons in all country provinces are used. Once the bases were obtained, they were processed and compiled at the cantonal level. The explanatory variables come from the National Survey of Employment, Unemployment, and Underemployment (ENEMDU, 2019), compiled by the National Institute of Statistics and Census (INEC). These explanatory variables are used to be able to evaluate them as determinants of COVID-19 cases in Ecuador. The independent variables defined for this study are: inequality, formal sector, primary sector, secondary sector, tertiary sector, sector, urban population, age, and female population. The dependent variable is the number of COVID-19 infections, compiled and processed from the information made available by the Ministry of Public Health of Ecuador (MSP, 2020). The statistics on COVID-19 infections are, as of July 24, 2020, a total of 70,093 people

infected and 5,460 deaths. The variables used in this research are described in Table 1, as well as their main descriptive statistics.

Table 1
Model variables

Variable	Description	Obs.	Mean	Std. dev.
	Dependent			
Log (Covid-19)	Logarithm of the number of confirmed COVID-19 cases in the canton	194	4.55	1.55
	Independent			
Inequality	Gini coefficient measuring cantonal income inequality; 0 indicates equality and 1 complete inequality	194	0.27	0.10
Formal sector	Percentage of the total population formally engaged in economic activities	194	34.26	19.86
Primary sector	Percentage of the total population that performs its labor activities in the branches of activity belonging to the primary sector, which correspond to extracting and obtaining raw materials.	194	53.29	25.94
Secondary sector	Percentage of the total population that performs its labor activities in the branches of activity belonging to the secondary sector, corresponding to the transformation of raw materials.	194	10.18	9.05
Tertiary sector	Percentage of the total population that performs its labor activities in the branches of activity belonging to the tertiary sector, corresponding to the provision of services.	194	36.54	21.95
Urban population	Percentage of the total population residing in urban areas	194	37.09	35.15
Age	Average age of the people in the canton	194	34.51	5.38
Female population	Percentage of the total population that belongs to the female gender	194	49.65	5.12

Note: Obs. = observations, Std. dev. = standard deviation
Source: created by the author based on data from ENEMDU (2019) and MSP (2020)

It is possible to preliminarily observe the degree of relationship of the variables used in the model in Table 2. At 5% significance, cases of COVID-19 and inequality, formal sector, primary sector, tertiary sector, and urban population have a significant relationship. However, the true effect of the explanatory variables on COVID-19 will be observed later, after estimating the equations to be described in the methodology section.

Table 2
Correlation matrix

	Log (Covid-19)	Inequality	Formal sector	Primary sector	Secondary sector	Tertiary sector	Urban population	Age	Female population
Log (Covid-19)	1								
Inequality	0.27*	1							
Formal sector	0.24*	0.16	1						
Primary sector	-0.38*	-0.21	-0.76*	1					
Secondary sector	0.19	0.04	0.27*	-0.58*	1				
Tertiary sector	0.37*	0.23	0.78*	-0.94*	0.28*	1			
Urban population	0.48*	0.14	0.54*	-0.70*	0.35*	0.68*	1		
Age	-0.19	-0.04	-0.14	0.09	-0.02	-0.09	-0.12	1	
Female population	0.05	-0.003	0.09	-0.10	0.16	0.05	0.09	-0.07	1

* $p < 0.05$
Source: created by the author based on data from ENEMDU (2019) and MSP (2020)

Furthermore, the correlation graph in Figure 1 illustrates the basic relationship between COVID-19 and inequality, presenting the existence of a positive relationship, i.e., as inequality increases, COVID-19 cases in the cantons increase. This preliminary relationship was seen earlier in the correlation matrix.
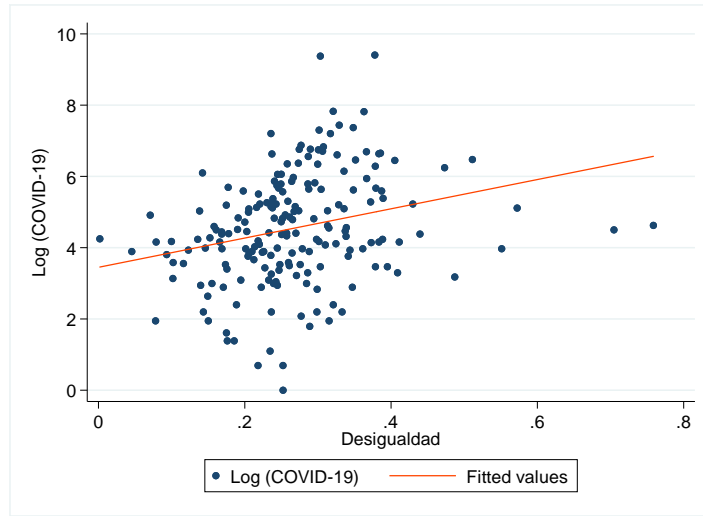
Figure 1. Relationship between COVID-19 and inequality in Ecuador 2020.
Source: created by the author based on data from ENEMDU (2019) and MSP (2020).

Econometric strategy

This research aims to evaluate the factors associated with COVID-19 infection in Ecuador, using data from official statistical sources in Ecuador and processing them with quantitative methods frequently used to study social and economic phenomena, such as the one evaluated in this research. Consequently, econometric methods are used with cutoff data through Ordinary Least Squares (OLS) to assess the effect of the independent variables on COVID-19 cases in Ecuador in 2020. The study takes as its basic analysis the relationship between COVID-19 and inequality:

$$COVID - 19 = f(Inequality)$$

(1)

From Equation 1, an econometric model is developed as follows:

$$COVID - 19_i = \alpha_0 + \beta_1 DI_i + \varepsilon_i$$

(2)

In Equation 2, $COVID - 19$ represents the logarithm of the cases of infection by COVID-19, DI represents income inequality measured by the Gini coefficient, and ε_i defines the error term of the equation. The term i represents the cantons used in the study, $i = 1,2,3,\ldots,193$. Then, a series of

economic, social, and demographic covariates, defined in Table 1, are included to verify the consistency of the basic regression estimators. Equation 3 formalizes the analysis with the covariates:

$$COVID - 19_i = \alpha_0 + \alpha_1 DI_i + \alpha_2 SF_i + \alpha_3 SP_i + \alpha_4 SS_i + \alpha_5 ST_i + \alpha_6 PU_i + \alpha_7 E_i + \alpha_8 PF_i + \varepsilon_i$$

(3)

Where SF represents the formal sector, SP the primary sector, SS the secondary sector, ST the tertiary sector, PU the urban population, E the age, and PF the female population. White's test (1980) tests for the existence of heteroscedasticity. However, the regressions were corrected by applying robust variance based on a list of equation-level scores and a covariance matrix.

Discussion of the results

The equations of the previous section are estimated using econometric techniques with cross-sectional data to examine the effect of economic, social, and demographic variables on COVID-19 infections in Ecuador. The results of the estimated regressions are presented in Table 3, which indicates that income inequality has a positive and statistically significant effect on COVID-19 cases in Ecuador. In the cantons, there is greater inequality among the population, which causes people without the necessary resources to remain in lockdown to be forced to return to their economic activities or to try to carry out another economic activity to cover their needs. This causes people to leave their homes and become more exposed to infection. These results confirm the hypothesis put forward at the beginning of this research. These results coincide with those found by Ahamed et al. (2020), who made estimates using 78 low- and lower-middle-income countries. They demonstrated that income inequality is a significant variable in explaining COVID-19 infections. Furthermore, they mention that it is essential to mitigate income inequality since it directly impacts the increase in the population living in poverty and extreme poverty.

Another aspect of inequality is that people do not have the money necessary to acquire all the medical supplies that help prevent contagion since money is required to frequently obtain perishable supplies, which are not affordable by the general public. On the other hand, the Ecuadorian state entities in charge of mitigating COVID-19 cases did not act on time in the pandemic distributing masks or other supplies to the general population, much less providing targeted programs for the most vulnerable people with scarce resources. This coincides with the statements of Laborde et al. (2020) in the literature review presented in this research. These authors mention that it is necessary to ensure that social protection programs provide financial stability to people with low incomes, at least to cover their food necessities. This recommendation is made especially for developing countries with much more marked income inequality.

Table 3
Regression results

	M1	M2	M3	M4	M5	M6	M7	M8
Inequality	4.105***	3.649***	3.113**	4.027***	3.042*	3.228***	3.959***	4.121***
	(3.86)	(3.47)	(3.06)	(3.85)	(2.95)	(3.39)	(3.78)	(3.87)
Formal sector		0.0164**						
		(3.03)						
Primary sector			-0.0205***					
			(-5.10)					
Secondary sector				0.0318**				
				(2.70)				
Tertiary sector					0.023^{1}***			
					(4.82)			
Urban population						0.019^{9}***		
						(7.20)		
Age							-0.0521**	
							(-2.63)	
Female population								0.0170
								(0.80)
Constant	3.450***	3.007***	4.801***	3.145***	2.885***	2.943***	5.288***	2.601*
	(11.35)	(9.08)	(12.32)	(9.84)	(9.29)	(10.55)	(6.96)	(2.36)
Remarks	193	193	193	193	193	193	193	193
Chi – square (p-value)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

t statistics in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Source: created by the author

For its part, the formality variable also indicates a positive and statistically significant relationship. It may be associated with the fact that in the cantons with a higher percentage of the population working in the formal sector of the economy, whether in private companies or public institutions or companies, there has been a requirement that a certain number of employees return to their jobs while the pandemic was still ongoing. Despite the safety measures, this situation causes people to have social interaction and contact each other, which increases the number of infections. The WHO (2020) drastically prohibited such a situation.

Another aspect to consider in the causes of the increase in COVID-19 infection is the economic sector to which the employed persons belong since each has its own particular characteristics. Thus, when the economically active population is concentrated in economic activities belonging to the secondary or

tertiary sector, COVID-19 infections increase because these are activities that take place in places where there is contact with many people. The service sector and the secondary sector involve activities that take place in enclosed spaces, such as factories and processing plants, among others, both of which are favorable settings for the number of infections to multiply when there is no adequate social distancing and no adequate application of sanitary measures to mitigate the virus. Likewise, the incidence of the COVID-19 crisis on employment and working conditions in the companies in the sample indicates that the situations described above are reflected in the salaried employees. Although 46.3% stated that they had not carried out any layoffs or firings, the rest had had to adopt these emergency labor measures. These measures have had less impact on new initiatives. This may be because these companies are the ones that have hired the fewest workers. In fact, 63.8% had no employees at all (Martínez et al., 2020).

On the contrary, economic activities carried out in the primary sector of the economy indicate the presence of a negative and statistically significant relationship. In other words, when the percentage of people is concentrated in this sector, COVID-19 infections decrease because it is an activity carried out in the countryside, where there is low population density. Furthermore, there is no direct contact with the final consumers of these products since they are generally carried out in peripheral areas, and the products are taken to urban centers or cities to be marketed.

These results based on the economic activity to which the individuals belong take on greater strength when examining how the location of the population is distributed in the cantons of Ecuador. For example, the urbanization variable indicates the presence of a positive and statistically significant relationship, which presents the expected relationship because the places with a greater concentration of urban population have a higher concentration of people. This is because economic activity is more highly developed, which causes more interaction between people and, in turn, exponentially increases COVID-19 infections in Ecuador. These results show a contrast when a higher percentage of people live in rural areas, i.e., infections decrease, unlike the urbanization variable.

The findings on the results of the age variable highlight one of the main details of the virus that the academic and scientific community has widely analyzed. Age presents a negative and statistically significant relationship, which means that the increase in the average age of the canton causes a decrease in the cases of infection. These results support the premise initially put forward by experts on this subject, who claimed that the elderly are the most vulnerable and most likely to die due to COVID-19 infection. The findings indicate that this group of people has taken the respective measures to avoid contracting the virus. These results are quite consistent with official sources since the age group between 20 and 49 years of age accounted for 58.9% of the total number of cases, while the age groups between 50 and 64 years of age and over 65 years of age accounted for 21.7% and 17.7%, respectively. Cruz et al. (2020) agree with the results since they mention that, although COVID-19 can infect people of all ages, the elderly and

12

those with pre-existing medical conditions seem to be more vulnerable to becoming seriously ill with the virus, with a reported mortality rate of more than 8% in people over 70 years of age. Most of the deceased patients had an average age of 56 years.

Finally, the effect on COVID-19 infections in Ecuador was evaluated according to gender. In this case, there is no significant difference between the number of women and men in the canton that could determine the number of virus infections.

Conclusions

The pandemic caused by the appearance of COVID-19 in China at the end of 2019 prompted great concern worldwide due to the social and economic effects it has caused on a large scale since the damage caused is incalculable. According to specialists in the field, it will take a considerable time for economies to return to normal activity. Several conditions have arisen for the virus to spread exponentially among the population, regardless of social, economic, religious, cultural, or geographical conditions.

Despite its recent appearance, different studies have already been carried out on COVID-19 worldwide, both qualitative and quantitative in all branches of knowledge, to understand its spread. As mentioned at the beginning, few studies establish inequality as one of the determinants of the spread of COVID-19 since, according to the literature review, most studies focus on examining inequality as an effect of COVID-19. Therefore, this research contributes to scientific and academic knowledge with the study of the determinants for the case of Ecuador, specifically inequality, through the use of information published by the official entities of the country and processed through quantitative methods using econometric strategies.

The results obtained provide clear indications that regions with greater inequality are a determining factor in COVID-19 since they reduce the possibilities for people to have access on their own to all the health products that help prevent COVID-19 infection. Similarly, it was found that economic activity is a clear driver of COVID-19 infection due to how these activities are undertaken. In the case of the primary sector, the activities are carried out in the open air, which is in line with what health entities claim: activities with a high density of people cause a greater amount of infection. These findings contrast with the results of the secondary and tertiary sector variables, which indicate that activities that have greater contact or social interaction or that take place in enclosed spaces, such as factories, become a focal point of virus transmission, as the WHO (2020) has mentioned throughout this pandemic.

As mentioned initially, previous research has examined inequality as a cause and effect of COVID-19; however, this study used the inequality variable as a determinant and is one of the first to be

carried out in Ecuador. Consequently, it is important to examine the effect that COVID-19 has had on inequality in Ecuador for future research.

The policy implications derived from this study establish that state aid should have focused on the families with the greatest income inequality since, due to the lack of resources, they were forced to ignore the lockdown to generate the resources to cover their needs. One of the main limitations of this study is that the analysis focuses only on cases of COVID-19 infection, not on deaths caused by the virus, since this information was available at the national level but not at the canton level. Therefore, it would be important to examine the lethality of SARS-CoV-2 in the country.

References

Ahamed, M., & Gutiérrez-Romero, R. (2020). COVID-19 response needs to broaden financial inclusion to curb the rise in poverty CGR. Working Paper 105. http://dx.doi.org/10.2139/ssrn.3616426

Atalan, A. (2020). Is the lockdown important to prevent the COVID-19 pandemic? Effects on psychology, environment and economy-perspective. Annals of Medicine and Surgery, 56, 38-42. https://doi.org/10.1016/j.amsu.2020.06.010

Banco Mundial (2020). Disponible en: https://www.bancomundial.org/. Consultado: 18/08/2020.

Bryce, C., Dowling, M., & Sadoghi, A. COVID-19, poverty traps, and global poverty discourse. Disponible en: https://www.researchgate.net/profile/Michael_Dowling15/publication/341782055_COVID19_ poverty_traps_and_global_poverty_discourse/links/5ed434654585515294527861d/COVID-19-poverty-trapsand-global-poverty-discourse.pdf. Consultado: 18/08/2020

Bukari, C., Essilfie, G., Aning-Agyei, M. A., Otoo, I. C., Kyeremeh, C., Owusu, A. A., ... & Bukari, I. K. (2020). Impact of COVID-19 on poverty and living standards in Ghana: A micro perspective. DOI: https://doi.org/10.21203/rs.3.rs-37910/v1

Comisión Económica para América Latina y el Caribe (CEPAL, 2020). Disponible en: https://www.cepal.org/es. Consultado: 15/08/2020.

Cruz, M.P., Santos, E., Cervantes, M. V., & Juárez, M. L. (2020). COVID-19, una emergencia de salud pública mundial. Revista Clínica Española. https://doi.org/10.1016/j.rce.2020.03.001

Encuesta Nacional de Empleo, Desempleo y Subempleo (ENEMDU, 2019). Disponible en: https://www.ecuadorencifras.gob.ec/empleo-encuesta-nacional-de-empleo-desempleo-y-subempleoenemdu/.Consultado: 15/08/2020.

Fernandes, N. (2020). Economic effects of coronavirus outbreak (COVID-19) on the world economy. SSRN. http://dx.doi.org/10.2139/ssrn.3557504

Kanitkar, T. (2020). The COVID-19 lockdown in India: Impacts on the economy and the power sector. Global Transitions, 2, 150-156. https://doi.org/10.1016/j.glt.2020.07.005

Instituto Nacional de Estadísticas y Censos (INEC 2020). Disponible en: https://www.ecuadorencifras.gob.ec/estadisticas/. Consultado: 15/08/2020

Laborde, D., Smaller, C., & Porciello, J. (2020a). What would it cost to avert the COVID-19 hunger crisis?. The International Institute for Sustainable Development. https://hdl.handle.net/1813/70172. Consultado: 18/08/2020

Laborde, D., Martin, W., & Vos, R. (2020). Poverty and food insecurity could grow dramatically as COVID-19 spreads. International Food Policy Research Institute (IFPRI), Washington, DC. Disponible en: https://www.researchgate.net/profile/Rob_Vos2/publication/343267777_Poverty_and_food_in security_could_gr ow_dramatically_as_COVID-19_spreads/links/5f20772345851515ef509bf7/Poverty-and-food-insecurity-couldgrow-dramatically-as-COVID-19-spreads.pdf. Consultado: 18/08/2020

Lau, H., Khosrawipour, V., Kocbach, P., Mikolajczyk, A., Schubert, J., Bania, J., & Khosrawipour, T. (2020). The positive impact of lockdown in Wuhan on containing the COVID-19 outbreak in China. Journal of travel medicine, 27(3), taaa037. https://doi.org/10.1093/jtm/taaa037

Lipsitch, M., Swerdlow, D. L., & Finelli, L. (2020). Defining the epidemiology of Covid-19—studies needed. New England Journal of Medicine, 382(13), 1194-1196. https://doi.org/10.1056/NEJMp2002125

Mamun, M. A., & Ullah, I. (2020). COVID-19 suicides in Pakistan, dying off not COVID-19 fear but poverty?-The forthcoming economic challenges for a developing country. Brain, Behavior, and Immunity. https://doi.org/10.1016/j.bbi.2020.05.028

Martínez, C.N., & Bañón, A.R. (2020). Emprendimiento en épocas de crisis: Un análisis exploratorio de los efectos de la COVID-19. Small Business International Review, 4(2), 53-66. https://doi.org/10.26784/sbir.v4i2.279

Ministerio de Salud Pública (MSP, 2020). Disponible en: https://www.salud.gob.ec/. Consultado: 15/08/2020.

Noorbhai, H. (2020). A mathematical model to guide the re-opening of economies during the COVID-19 pandemic. Annals of Medicine and Surgery, 57, 5-6. https://doi.org/10.1016/j.amsu.2020.06.041

Organización Mundial de la Salud (OMS, 2020). Disponible en: https://www.who.int/es/. Consultado: 15/08/2020

Ruiz Estrada, M. A. (2020). Is Poverty the Best Allied of COVID-19 in Developing Countries? The Case of Guatemala. The Case of Guatemala (July 7, 2020). http://dx.doi.org/10.2139/ssrn.3645045

Santos, M., Lucena, E. E., Lima, K. C., Brito, A. A., Bay, M. B., & Bonfada, D. (2020). Survival and predictors of deaths of patients hospitalized due to COVID-19 from a retrospective and multicenter cohort study in Brazil. medRxiv. https://doi.org/10.1101/2020.06.07.20125047

Saunders, M. J., & Evans, C. A. (2020). COVID-19, tuberculosis, and poverty: preventing a perfect storm. The European Respiratory Journal. https://doi.org/10.1183/13993003.01348-2020

Singh, B. P. (2020). Impact of COVID-19 on Rural Economy in India. University Library of Munich, Germany. Available at SSRN 3609973. http://dx.doi.org/10.2139/ssrn.3609973

Suryahadi, A., Al Izzati, R., & Suryadarma, D. (2020). The Impact of COVID-19 Outbreak on Poverty: An Estimation for Indonesia. SMERU Working Paper. Disponible en: https://www.researchgate.net/profile/Ridho_Al_Izzati/publication/341151146_The_Impact_of_COVID19_Outbreak_on_Poverty_An_Estimation_for_Indonesia/links/5eb1224a299bf18b95 95b694/The-Impact-ofCOVID-19-Outbreak-on-Poverty-An-Estimation-for-Indonesia.pdf. Consultado: 18/08/2020

Thakur Vikram, & Jain Anu. (2020). COVID 2019-suicides: A global psychological pandemic. Brain, Behav. Immunity. 2020 doi: 10.1016/j.bbi.2020.04.062. https://doi.org/10.1016/j.bbi.2020.03.022

Timmermann, C. (2020). Epistemic ignorance, poverty and the COVID-19 pandemic. Asian Bioethics Review, 1-9. https://doi.org/10.1007/s41649-020-00140-4

Valensisi, G. (2020). COVID-19 and global poverty: Are LDCs being left behind? (No. wp-2020-73). World Institute for Development Economic Research (UNU-WIDER). Disponible en: https://ideas.repec.org/p/unu/wpaper/wp2020-73.html. Consultado: 18/08/2020

White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. Econometrica: Journal of the Econometric Society, 817-838. https://doi.org/10.2307/1912934