Economic Uncertainty During COVID-19 Pandemic in Latin America and Asia

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Abstract

The purpose of this article is to analyze the impact of COVID-19 pandemic on inflation and exchange rate volatility and to study the government measures implemented in order to support economies. Based on monthly data from January to September 2020 for 10 countries, the dynamic panel data model is used to study the effect of COVID-19 spread. The results reveal that high infections negatively affect exchange rate and inflation; the responses of governments increase inflation and result in a lower exchange rate. In fact, providing health protocols which entered the countries into a new economic and financial crisis since economic agents could not freely engage in economic activities. Therefore, policy makers in both regions should invest in health infrastructure to improve the capacity of the national health system to resist the epidemic of contagious diseases.

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Introduction

Since the 1990s, Latin America and Asian countries have experienced several periods of economic and financial crisis. Economic crises are often caused by market instability (Di Quirico, 2010; Khang et al., 2005; Hart & Tindall, 2009; Stiglitz, 2009; Chauffour & Farole, 2009; Petrakos, 2014), foreign trade and price shocks (Mendis, 2002; Francois & Woerz, 2009), political instability (Aisen & Veiga, 2013; Gasiorowski, 1995; Lagravinese, 2015), and civil unrest through the protests (Bartels & Bermeo, 2014; Grasso & Giugni, 2016; Bernburg, 2016). During the economic crisis of 1997 and 2008, a banking and financial crisis occurred which resulted in a slowdown in growth and a deterioration of the external position for the Asian and Latin countries. The appreciation of the dollar is explained by the loss of competitiveness of these countries, the deterioration of their external markets, the over-investment in unprofitable sectors (real estate), and the indebtedness of their domestic agents with foreign banks without foreign exchange risk hedging (Francois & Woerz, 2009; Jones, 2016). In previous years, the World Health Organization revealed various epidemics that infected a significant number of citizens around the world. China has been affected by several epidemics including SARS which spread in 2003 and affected more than 8000 citizens. In 2002, the silent epidemic of HIV/AIDS reached alarming proportions, affecting nearly 2 million people in Latin America.

Recently, both regions have been devastated by pandemic uncertainty of Chinese origin. According to WHO (2020), this global pandemic of coronavirus disease (COVID-19) is among the most serious health crises in human history (Fonds Monétaire International, 2020; Toquero, 2020; Almarayeh & Almarayeh, 2021; Ashraf, 2020). On January 30, 2020, the WHO announced an international public health emergency prior to the formal declaration of COVID-19 as a pandemic. Recently, a new pandemic was reported in Wuhan, a city in China, which has spread rapidly and has prominently distracted the lives of people around the world. Palese (2004) confirmed a 5% drop in gross domestic product in the USA following the flu. Hai et al. (2004) found that EBOLA caused more than 11,300 deaths worldwide, pain in the money market for the USA through an economic deficit of $53 billion. Financial Times (2020) declared that 400,013 have died from COVID-19 worldwide since June 07, 2020. The balance sheets continue to grow especially in Latin America, where Brazil is among the most affected countries with 36,455 deaths including 691,758 cases. Mexico, too, has passed 46,000 deaths and has become the third country in the world in terms of coronavirus-related deaths.

This COVID-19 epidemic negatively influenced the economic environment and caused the deterioration of the gross domestic product by 1%. In fact, it has caused economic damage of $54 billion worldwide. It is against a backdrop of low inflation, low interest rates, and bleak growth prospects that the coronavirus or COVID-19 is hitting the world. This pandemic has negative consequences on economic activity following government measures such as the decrease in production and tax revenues resulting in an increase in household aids such as transfers of unemployment benefits and wage subsidies (McKibbin & Fernando, 2020; Atkeson, 2020; Baldwin & Tomiura, 2020; Cecchetti & Schoenholtz, 2020; Mann et al., 2020; Meninno &

Wolff, 2020; Voth, 2020; Cochrane, 2020; Wren-Lewis, 2020; Wyplosz, 2020; Baker et al., 2020; Albulescu et al., 2021).This would worsen the budget balances (worsening budget deficits) of most countries in the world and increase the public debt ratios of some (in 2019, public debt represented 83% of global GDP), as the IMF maintains (2020) in its report on the effects of COVID-19 on public finances around the world.

With great concern, the world is preparing to deal with the economic and social impact of the COVID pandemic by assessing the avenues and opportunities to reduce its impact. The COVID-19 pandemic has had a significant impact on the global economy; it has touched the global travel industry, national health systems, the food industry, education and global commerce. Due to globalization, spillover effects on emerging and developing countries are expected due to their dependence on developed countries for the import of goods and services (Ozili & Arun, 2020). According to the World Bank (2020), the COVID-19 pandemic is destabilizing the world economy and would lead it to a recession due to the decline in activity observed in China (during the first quarter of 2020) and which should impact other countries hit by the pandemic, in particular the USA and the Eurozone. According to WHO, the pandemic cost 41 billion Euros. This figure includes the fall in tourism revenues (-80% in China) and a shortfall of the order of 50% for airlines, tourist agencies, restaurants, and taxi drivers. In 2003, South East Asia fell by 2% of GDP in the second quarter of 2003. The slowdown in commodity prices since 2014 and an imminent crisis in China before the market pandemic particularly affected Latin America, leading to currency depreciation. The COVID-19 crisis has aggravated the low international position of Latin American currencies and their degree of convertibility. In March 2020, the real Brazilian peso, the Colombian peso, and the Mexican peso depreciated by more than 10% against the US dollar, while the currencies of Chile and Peru depreciated by about 5% (UNCTAD, 2020). In other words, the COVID-19 pandemic has led to international production risks induced by international trade shocks, including the Tōhoku earthquake and the 2011 tsunami in Japan and the 2011 floods in Thailand. In addition, Latin American exports entered negative territory for the first time since 2015, with an estimated 29.5% year-on-year in the first half of 2020. This is explained by the slowdown in exports to important markets such as the USA (-19.5%), the European Union (-18.6%) and China (-1.0%).In addition, this pandemic has led to a drop in production and, in turn, a fall in the profits or profits of firms, lower wages, lower demand, increased social pressures, and uncertainty. This leads us to say that the world is facing a twin crisis, both health and economic (Dauvin et al., 2020; Fernandes, 2020). According to Martin et al. (2020), tensions in the goods and services market and that of foreign exchange, budget deficits, declines in imports and exports, a contraction in economic activity with containment measures, the decline in the power of purchase, and worsening poverty tend to limit the state's room for maneuver in the response to COVID-19.

In response to this severe outbreak, governments around the world have rushed in with emergency actions, such as lockdowns, travel restrictions, public events canceling, and social distancing. Against this background, Hoof (2020) noted that a third of the world's population has undergone the lockdown measure to curb the spread of this pandemic. Additionally, United Nations Conference on Trade and Development/

UNCTAD ([2020](#)) found that 48 countries have implemented a partial or full lockdown. Moreover, governments have developing several responses in terms of economic as well as heath measures, to address the consequences of COVID-19. In fact, these actions might reduce the negative impact of COVID-19 and prevent from an economic and financial recession. However, their effectiveness depends on the severity of the epidemic's spread.

Several empirical studies have been developed to assess the impact of coronavirus disease on financial and economic systems. Some studies have studied the effect of COVID-19 on financial markets (Alfaro et al., [2020](#); Ali et al., [2020](#); Altig et al., [2020](#); Ashraf, [2020](#); Dai et al., [2021](#); He et al., [2020](#); Louhichi et al., [2021](#); Zhang et al. [2020](#), among others). Other studies have investigated the economic impact in the era of COVID-10 (Gans, [2020](#); Susskind & Vines, [2020](#); among others). All of these factors have contributed to significant macroeconomic instability. This is why understanding the above horrors of COVID-19 and revisiting macroeconomic variables is a crucial moment. This literature, to the best of our recognition, has overlooked the interaction effects between Corona and government interventions. Our study aims to complete this literature by evaluating the macroeconomic aggregates at the age of COVID-19 by considering the government response as well as the intensity of the pandemic. For clarity, our study provides comprehensive information on the pandemic and its impact on the most important macroeconomic variables. Therefore, we aim to examine the exchange rate and inflation which may cause economic instability or crises in conjunction with the coronavirus outbreak in the two worst affected regions of the world. We examine the reaction of the inflation rate and the exchange rate to three types of government actions, including the government response index, the economic support index, the total number of school closures, among others. We choose regions of Asia and Latin countries because on July 26, 2020, the Latin American region becomes the most affected in the world in terms of the number of coronavirus infections, and scenes of corpses in the streets in Ecuador.

Based on monthly data from January to September 2020 for 5 Asian countries (Malaysia, India, Indonesia, Japan, and China) and the 5 Latin countries (Argentina, Brazil, Mexico, Colombia, Ecuador), we are studying the expected economic impact of government actions to fight this unexpected pandemic. The choice of this period is motivated by our objective of evaluating the first wave of the pandemic. On the one hand, our analysis focused on two economic variables such as inflation and the exchange rate since they can create an economic uncertainty, where they are collected from the DataStream database. On the other hand, COVID-19 news data is measured across monthly confirmed COVID-19 cases for each country on the Coronavirus Resource Center (JHU-CRC) website at Johns Hopkins University. Deeper, we use the Coronavirus Government Response Tracker composite index developed by the University of Oxford and based on 5 response indicators to specify and confirm the expected economic impact of government actions such as the government response index and the economic support index, the closure and confinement of schools and the health index, during the COVID-19 pandemic.

While the performance implications of the determinants of economic growth differ and vary across a number of factors, our empirical results show that government measures have a dual impact on economic indicators. Moreover, while these

measures are accompanied by a significant increase in inflation, they significantly reduce the exchange rate.

Most importantly, the increase in confirmed cases reduces both inflation and the exchange rate due to an increase in demand over supply. This could be partly explained by the fact that the virus was first discovered in China and that the Asian and Latin economies are based on export and tourism and are therefore facing a free fall in productivity and a dramatic drop in GDP. In this context, there are several channels through which this epidemic will affect economic activity in Latin countries and Asia.

Thus, the remainder of this study is organized as follows: "Literature Review" presents the literature review. "Data sample and methodology" details the data use and empirical methodology. "Results and Discussion" deals with results and discussion. The last section "Conclusion" is devoted to the main conclusions and policy implications.

Literature Review

The literature on the economic crisis is vast and shows that these crises have significant harmful consequences (Honkapohja & Koskela, 1999; Cheong, 2001a, b; Sanusi, 2010 Carneiro et al., 2014; Devakuma et al. 2020), in their analysis of the economic crisis in Portugal, prove the existence of job destruction due to the collapse of existing businesses, the increase in the unemployment rate, and the wage freeze. Recently, Baker et al. (2020) analyzed the effect of stock market volatility, newspaper economic uncertainty, and subjective uncertainty in surveys of business expectations on the US economy. They found an 11% contraction in US real GDP in the fourth quarter of 2020. Even the confidence interval fell from 90 to 20% during this pandemic. With the same idea, Dai et al. (2021) examined the effect of economic policy uncertainty (UPR) on the risk of a US stock crash during the COVID-19 pandemic. On the basis of a GARCHS (GARCH with skewness) model, they estimated the daily asymmetry as a proxy of the risk of stock crash. The empirical results show a significantly negative correlation between the UPR and the risk of a stock crash. Therefore, the worsening of the UPR plays a major role in increasing the risk of a stock market crash. After the pandemic, they confirmed that this correlation is strengthening and that the risk of a US stock crash will be strongly influenced by the UPR. Along the same lines, Al-Thaqeb et al. (2020) studied the relationship between economic policy uncertainty (UPE) on individuals, businesses, governments, and economies at the local and international levels. The empirical results show that government uncertainty also affects financial, real estate, and stock markets, debt issues, and the whole economy. This underlines the importance of considering UPE as a risk factor. In this context, Caggiano et al. (2020) analyzed the effect of the COVID-19 pandemic on industrial production. Using a VAR model, they found a (cumulative over 1 year) peak negative response from global industrial production of 1.6% (14%). They confirmed the importance of the massive political interventions put in place around the world to combat the recessive effects of the COVID-19 shock. In the Brazilian context, Magazzino et al. (2021) examined the

relationship between economic growth and renewable energy consumption during the COVID-19 pandemic. Through a model of artificial neural networks, they found that increasing consumption of renewable energy triggers acceleration in GDP relative to other energy variables. Consequently, this acceleration could be useful in the fight against the global pandemic. These results are confirmed with the studies of Mele et al. (2021) that analyzed the same relationship through an LSTM model and found that an ever greater use of renewable energies can support the recovery of economic growth during health crises. In the same context, Magazzino et al. (2021a, b) studied the causal relationship between economic growth, pollutant emissions, and deaths from COVID-19 in New York. They found a one-way causality between economic growth and $PM_{2.5}$, CO_2, and NO_2. Their ML analysis, with the D2C algorithm, showed a direct relationship between the concentration of $PM_{2.5}$ and deaths from COVID-19. They concluded that the higher and more constant the exposure to PM (PM_{10}, $PM_{2.5}$) over time (as in the elderly), the greater the likelihood that the respiratory system is predisposed to more serious illness. In the Indian context, Mele and Magazzino (2021) studied the relationship between pollution emissions, economic growth, and deaths due to COVID-19 through an approach of time series and annual data over the period from 1980 to 2018. Empirical results show causality between economic growth and pollution. Then, based on daily data from January 29 to May 18, 2020, they analyzed the relationship between confirmed deaths and air pollution concentration levels for 25 major Indian cities. They verified an ML causal link between PM_2 deaths. In South America, Morales and Sachs (1989) show that Bolivia has experienced money market disturbances such as hyperinflation reduced lending in international capital markets and falling world prices for commodity exports. As a result, the government lowered the interest rate for homeowners because of this hyperinflation.

Thus, the coronavirus pandemic is attracting the attention of researchers with such damaging consequences. Ashraf (2020) Dev and Sengupta (2020) and Fernandes (2020) have shown that the COVID-19 pandemic had negative consequences on stock markets for emerging countries. Few studies have confirmed the negative impact of the COVID-19 epidemic on the early Chinese economy (Al-Awadhi et al., 2020; McKibbin & Fernando, 2020). China's economy is export-oriented, and any significant change in exports due to COVID-19 can affect its exchange rate. According to Financial Times (2020), there is a consensus that the coronavirus pandemic will plunge the world into a global recession. Similarly, Velde (2020) reported that economic activity has experienced significant daily supply and demand disruptions since the announcement of the COVID-19 pandemic. In addition, Barro et al. (2020) used annual aggregate data for a representative sample of countries and found evidence of significant negative effects of pandemic mortality on GDP and positive effects on inflation. These results are confirmed by Correia et al. (2020). To avoid contracting the virus, households reduce their consumption and supply of labor (Martin et al., 2020), while businesses reduce their investments in response to declining demand, increasing uncertainty and labor shortages. Fernandes (2020) analyzed the economic impact of the coronavirus crisis on industries and countries. He provided estimations of the

potential global economic costs of COVID-19 and the GDP growth of different countries. Using a sample of 30 countries, the results showed a drop in economic growth in these countries explained by government actions. Along with this line of thought, Horowit (2020), Elliot and Sumeet (2020), El-Erian (2020), Fernandes (2020), Ozili and Arun (2020) have shown that the economic pain has become severe as people have been urged to stay in their homes, and the gravity has been felt in various sectors of the economy with travel bans affecting the aviation industry, cancellations of sporting events, etc.

This literature, to the best of our recognition, has overlooked the effects between Corona and government interventions. Our study aims to complete this literature by assessing the uncertainty of macroeconomic aggregates at the age of COVID-19 considering the government's response as well as the intensity of the pandemic.

Data Sample and Methodology

Data Sample

We study the impact of COVID-19 spread on both inflation and exchange rate for 5 Asian countries (Malaysia, India, Indonesia, Japan, and China) and the 5 Latin countries (Argentina, Brazil, Mexico, Colombia, Ecuador). The inflation is the average change in price index, and the exchange rate is the value of national currency versus the US dollars. The impact of the pandemic COVID-19 is highlighted by several variables such as coronavirus cases (CAS), the percentage of school closures (SCH), the containment and health index (CONT), the government response index (GOVR), and economic support. We introduce the government measures in order to support economies indicating the level of governmental actions deployed to lessen the fatal impacts of the coronavirus. The government response index (GOVR)is a composite measure based on 7 response indicators, including school closures, workplace closures, and travel bans, rescaled to a value from 0 to 100 (Table 1).

In order to measure the efficiency of governmental measures, we insert the interaction variable: CAS×GOVR measuring the potential impact of the GOVR to reduce the fatality of the pandemic. Macroeconomic data are collected from the IMF database, and the CAS data are taken from the Coronavirus Resource Center (JHU-CRC) website at Johns Hopkins University. GOVR data are collected from the Oxford COVID-19 Government Response Tracker (OxCGRT) website.

Table 2 reports summary descriptive statistics for main variables. The CAS variable has a mean value of 1.84 with a standard deviation of 1.84 confirming the random walk property of the number of confirmed cases. The 26.349 mean values of ECOS indicate the growing effort made by governments in order to minimize fatal impact of the virus on the economy. The minimum and maximum values of GOVR show that governments have responded with significant changes in policies.

The skewness statistics during the studied period showed that the marginal distributions are asymmetrical to the right for which the values are positive, except for the containment and health index, stock index, and exchange rate with a negative value suggesting that the marginal distributions are asymmetrical to the left. Testing for

Table 1 Variable definitions

Variable		Measurement	Indication
Dependent variables	Inflation	The Consumer Price Index (CPI) measures the changes in the cost of a basket of goods and services consumed by the average urban household	INF
	Exchange rate to USD	Exchange rates are defined as the price of one country's currency against the currency of another country. This indicator is measured in terms of national currency per US dollar	EX
COVID	COVID-19 cases	Number of confirmed cases	CAS
	Population	The cumulative number for 14 days of COVID-19 cases per 100,000 persons	POP
Government measures	Government responsibility	Government policy announcements regarding public awareness campaigns, testing policy, and contact tracing	GOVR
	Economic support	Government announcements of income support and debt relief, contracts for households	ECOS
	Containment and health index	This is a composite measure based on the screening policy and contact tracing	CONT
	School closing due to COVID-19	The monthly number of schools closed	SCH
Control variables	Lending rate	The real interest rate is the interest rate on loans adjusted for inflation, as measured by the GDP deflator	LR
	Stock index	The opening price of stock market indices	SI
	Central bank rate	The real interest rate is the interest rate on loans adjusted for inflation, as measured by the GDP deflator	CR
	Unemployment	Unemployment, total (% of total labor force) (national estimate)	UP
	Output gap	The output gap is the difference between the real output and the potential output of the economy	OG

Table 2 Descriptive statistics

Variable	Obs	Mean	Std. dev	Min	Max	Skewness	Kurtosis
CAS	90	0.0184	0.0175	0	0.0166	9.3279	88.0112
GOVR	89	0.0327	0.0550	0	0.0143	1.4213	3.1277
ECOS	90	26.3491	31.1274	0	75	0.6827	1.6959
CONT	89	50.5869	22.4749	0	87	−0.7303	3.2845
SCH	89	15.85453	24.7492	0	75	1.5435	3.9685
LR	90	14.0031	9.0803	4.8	50.49	1.9981	6.2914
EX	90	2691.19	1756.147	4.0863	3870.578	−0.8612	1.7566
SI	90	61.6260	37.4877	1.9354	86.3342	−0.8858	1.8026
INF	90	147.044	7.905604	141.5289	171.6084	2.5862	7.9256
CR	90	7.040378	10.89325	2.187	50	2.7113	8.6298
POP	90	0.0451	0.0677	0	0.0211	1.5050	3.9366
OG	90	0.0760	0.0149	−325,147.3	0.0549	2.4771	7.6443
UP	90	9.24493	9.156677	2.3145	41.8087	1.7325	5.4508

heavy-tailed or light-tailed relative to a normal distribution, the Kurtosis statistics' low values suggest the existence of thin tails in return distributions especially during COVID-19 except for cases with a high raise.

Methodology

The purpose of this study is to investigate the effect of COVID-19 and government measures on economic indicators such as inflation and exchange rate in Latin America and Asian countries. The generalised generalized method of moments (GMM) system as proposed by Arellano and Bover (1995) is employed following prior studies such as by Saona (2016) and Dietrich and Wanzenried (2014). This method accounts for endogeneity by using the lagged values of the dependent variable and the lagged value of other regressors which are potentially suffering from endogeneity as instruments. We instrument for all regressors except for those which are exogenous. The GMM system also controls for unobserved heterogeneity and the persistence of the dependent variable. Finally, this estimator yields consistent estimations of the parameters. The estimated coefficients are also more efficient using an ampler set of instruments. Markus (1979) and Finkel (1995) focus mainly on using panel data to correct for measurement error while Green and Yoon (2002) studied the usefulness of the panel models. In line with these previous researches, Wawro (2002) argue that dynamic panel models include as part of their specification both lagged-dependent variables and unobserved individual-specific effects. Consequently, these models are very powerful tools that allow for empirical modeling of dynamics while accounting for individual-level heterogeneity. They enable us to parse out whether past behavior directly affects current behavior or whether individuals are simply predisposed to behave one way or another. Consequently, we use dynamic panel regression in order to study the economic effects of coronavirus outbreak (COVID-19) on the economy of Asian and Latin countries.

The above arguments suggest the application of a dynamic model that takes the following form:

$$y_{i,t} = \lambda y_{i,t-1} + \beta x_{i,t} + u_{i,t} \tag{1}$$

where: i denotes the cross-sectional units ($i = 1, \ldots, N$), t denotes the time period ($t = 1, \ldots, T$), $x_{i,t}$ is a vector of exogenous explanatory variables, λ and β are parameters to be estimated and $u_{i,t}$ is a random disturbance term. For the disturbance term, we assume according to Wawro (2002) that:

$$E[u_{i,t} | y_{i,t-1}, \ldots, y_{i,1}, x_{i,t}, x_{i,t} - 1, \ldots, x_{i,1}] \tag{2}$$

Consequently, we postulate that the disturbance term has a null mean provisional on all past and present values of the exogenous variables and past values of the endogenous variable. Doing so, we ignore the individual-specific effect, αi that was relegated in the disturbance term. ($u*_{i,t} = \alpha_i + u_{i,t}$).

In fact, it is common to remove individual-specific effects because it allows the removal of the problem of correlation between the lagged-dependent variable and the individual-specific component in the error term. Thus, it does not remain important to conceive them as fixed or random in the original model. However, these transformations create another kind of correlation between the disturbance and the lagged-endogenous variable in the converted equation. Therefore, we use instrumental variables in order to remove this problem. Following Wawro (2002), we use dynamic panel regression in order to study the economic effects of coronavirus outbreak (COVID-19) on the economy of Asian and Latin countries. In fact, we try to answer the following two questions: What is the impact of the spread of the pandemic on inflation and stock exchange? How do government interventions prevent a health crisis bring the global economy to its knees? The answer lies in the use of moderating variables to assess the impact of government measures in the context of the coronavirus. Besides, the dynamic panel provides the opportunity to analyze valuable information and study causal relationships more methodically since they offer the ability to examine variation within and across cross-sectional units and unobserved effects. Our empirical study aims to detect the impact of the global pandemic on economy in Asia and Latin America. Particularly, we study the impact on inflation approximated by the Consumer Price Index (CPI) that measures the changes in the cost of a basket of goods and services consumed by the average urban household and exchange rate measured by the price of one country's currency against the currency of another country in terms of national currency per US dollar. We further approximate COVID-19 by both CAS and POP measuring successively the number of confirmed cases and the cumulative number for 14 days of COVID-19 cases per 100,000 persons. We also include interaction variables between government measures and COVID-19 in order to capture the efficiency of these measures in the context of the spread of the virus. Finally, we insert different control variables in order to avoid bias in the estimations. Thus, we include the lending rate, stock index, central bank rate, unemployment rate, and output gap. Doing so, we improved the explanatory power our models. To reach this goal, we propose the following equations:

$$INF_{i,t} = \lambda INF_{i,t-1} + \beta_1 COVID_{i,t} + \beta_2 GOVR_{i,t} + \beta_3 GOVR_{i,t} \times COVIDi,t + \beta_4 CV_{i,t} + U_{i,t}$$
(3)

$$EX_{i,t} = \lambda EX_{i,t-1} + \beta_1 COVID_{i,t} + \beta_2 GOVR_{i,t} + \beta_3 GOVR_{i,t} \times COVIDi,t + \beta_4 CV_{i,t} + U_{i,t}$$
(4)

With;

INF and *EX* are the dependent variables measuring inflation and exchange rate. COVID is a vector measured by both CAS and POP. GOVR is a vector of government deployed actions to control the spread of the pandemic measured by either GOVR, ECOS, CONT, and SCH. LR, OG, UP SI, and CR are control variables (CV). (See Table 1 for detailed definitions of the variables). $U_{i,t}$ is the error term. We present below the detailed equations of all models employed.

$$INF_{i,t} = \lambda INF_{i,t-1} + \beta_1 CAS_{i,t} + \beta_2 GOVR_{i,t} + \beta_3 LR + U_{i,t}$$
(5)

$$INF_{i,t} = \lambda INF_{i,t-1} + \beta_1 CAS_{i,t} \times GOVR_{i,t} + \beta_2 ECOS_{i,t} + \beta_3 EX_{i,t} + U_{i,t}$$
(6)

$$INF_{i,t} = \lambda INF_{i,t-1} + \beta_1 CAS_{i,t} + \beta_2 CON_{i,t} + \beta_3 SCH_{i,t} + \beta_4 SI_{i,t} + U_{i,t}$$
(7)

$$INF_{i,t} = \lambda INF_{i,t-1} + \beta_1 CAS_{i,t} + \beta_2 POP_{i,t} + \beta_3 OG_{i,t} + \beta_4 UP_{i,t} + U_{i,t}$$
(8)

$$EX_{i,t} = \lambda EX_{i,t-1} + \beta_1 CAS_{i,t} + \beta_2 POP_{i,t} + \beta_3 LR_{i,t} + U_{i,t}$$
(9)

$$EX_{i,t} = \lambda EX_{i,t-1} + \beta_1 CAS_{i,t} \times GOVR_{i,t} + \beta_2 GOVR_{i,t} + U_{i,t}$$
(10)

$$EX_{i,t} = \lambda EX_{i,t-1} + \beta_1 CAS_{i,t} \times CR_{i,t} + \beta_2 POP_{i,t} + U_{i,t}$$
(11)

$$EX_{i,t} = \lambda EX_{i,t-1} + \beta_1 CAS_{i,t} + \beta_2 POP_{i,t} + \beta_3 OG_{i,t} + \beta_4 UP_{i,t} + U_{i,t}$$
(12)

Results and Discussion

The different models allow us to figure out the separate effect of each of COVID, government measures, and control variables. The first model is the base line model where we examine the impact of the virus on inflation and exchange rate. Then, we include interaction variables between COVID proxies and governments' responsibility index. Then, we test for the effect of government measures such as stringency index, containment and health index, and school closing index. In the fourth model, we intend to test for control variables as output gap, unemployment, central bank rate, lending rate, and stock index considered as macroeconomic measures. Tables 3 and 4 report the main empirical results. Model 1 is in both cases the baseline specification.

Table 3 Impact of the COVID-19 and the government measures on inflation

$INF_{i,t}$	Model 1		Model 2		Model 3		Model 4	
	Coef	Prob	Coef	Prob	Coef	Prob	Coef	Pob
$INF_{i,t-1}$	0.7573***	0.000	0.9195***	0.000	0.9904***	0.000	0.8600***	0.000
ECOS			0.0072*	0.085				
CAS×GOVR			0.0899*	0.10				
EX			0.0008*	0.07				
LR	−0.0394*	0.098						
GOVR	0.0214*	0.364						
CAS	−0.02921*	0.068			−0.0776	0.225	0.0305	0.722
SI					−0.0071*	0.080		
CONT					0.0168***	0.000		
SCH					−0.0059	0.257		
POP							−0.0399	0.215
OG							0.0851***	0.0194
UP							−0.0119	0.037
F(prob)	0.225 (0.000)		127,077.49 (0.000)		14,274.52 (0.000)		77.47(0.000)	
AR(2) test	−0.58		−1.49		1.34		−0.38	
Sargan test	9.27		0.234				15.18	
Hansen test	0.180		4.28		1.91		5.10	

***; ** and * indicate statistical significance at the 1% and 5% and 10% levels, respectively

The Fisher test identifies the overall significance of the variables. The AR2 test is the Arellano–Bond test for the existence of the second-order autocorrelation in the first differences. The Sargan test and the Hansen test refer to the over identification test for the restrictions in GMM estimation. Empirical results reveal that the number of infected cases reduces the inflation rate and the exchange rate with respectively 2.921% and 2.68%, which is confirmed by studies by Mann et al. (2020) and McKibbin and Fernando (2020) who have found that the rapid spread of COVID-19 and increased shocks from measures to contain it exerted disinflationary pressures in 2020 in major advanced economies. To confirm this finding, we include another proxy for COVID-19, POP measuring the cumulative number for 14 days of COVID-19 cases per 100,000 persons and we find a significant negative coefficient around 1%. According to IMF (2020), the inflation rate fell from + 0.7% to − 1.4% in Japan during January and December 2020. On the side of the main emerging economies, especially China, inflation closed l year 2020 with + 0.2% in December, after recording + 5.4% in January 2020. Governments that include the index of economic support and government responsibility leads to an increase in inflation (respectively of 0.72% and 0.02%) in Asian countries and Latin countries which is confirmed with the results of Baker et al. (2020). On the other hand, these government measure indexes have a negative effect on the country's exchange rate (6.5%). The interest rate affects negatively the inflation (3.94%) according to Keynesian theory, but the effect on exchange rate is insignificant. From the point of view of Ashraf (2020), the stability of the

Table 4 Impact of the COVID-19 and the government measures on the exchange rate

$EX_{i,t}$	Model 1		Model 2		Model 3		Model 4	
	Coef	Prob	Coef	Prob	Coef	Prob	Coef	Prob
$EX_{i,t-1}$	0.0856***	0.000	1.0471***	0.000	0.8572***	0.000	0.2093	0.203
CAS	−0.0268**	0.022					0.0148	0.437
POP	−0.0189**	0.021			−0.0105***	0.000	0.0019**	0.016
LR	−0.0115	0.298						
CAS×GOVR			−0.0795***	0.000				
GOVR			−0.0658***	0.000				
CAS×CR					−0.0496***	0.000		
OG							−0.012*	0.044
UP							−0.0098747***	0.014
F(prob>F)	0.0615*** (0.000)		0.0615*** (0.000)		0.0134*** (0.000)		26.78*** (0.000)	
AR(2) test	−1.00		−1.00		−1.00		−0.95	
Sargan test	8.58		7.61		8.58		5.54	
Hansen test	8.94		9.36		9.70		3.74	

***, ** and * indicate statistical significance at the 1% and 5% and 10% levels, respectively

money market provides particularly useful signs in complex and rapidly changing situations. Companies that are downsizing are starting to report significant drops in earnings. With the shortage of consumer goods in this period, inflation could recover quickly, with rising interest rates, oil prices returning to market prices. At the same time, fears of the onset of a new financial crisis linked to unmanageable state debt overhang are growing.

Beyond the health consequences, Latin America must face the fall in the prices of raw materials, the flight of capital, the fall in tourism, and especially the devaluation of its local currencies. In this context, there are several channels through which this epidemic will affect economic activity in Latin countries and in Asia. In fact, this fall is explained by a severe shock on supply and demand and despite the USA-China trade truce, Chinese exports to the USA remain heavily taxed and is almost stopped due the COVID-19 propagation. Inflation is also expected to continue to worsen in the coming months for all Central Asian countries where the offer exceeds the demand due to the closing of the borders and also these countries are export-oriented. In fact, Martin et al. (2020) postulate that in the context of the pandemic propagation, households diminish their demand. Besides, the reduction of the value of national currencies could be in part explained by the free fall since the onset of the health crisis. In order to improve the robustness of our results, we include the second proxy of COVID-19 "POP" which measures the cumulative number for 14 days of COVID-19 cases per 100,000 persons. We prove the same impact on both inflation and exchange rate.We include government response and economic support indexes through interaction variables in Model 2 measuring the moderating impact of government measures in the context of the propagation of the virus. This allows us to examine how government actions interact with the growth in COVID-19 confirmed cases. We also include proxies for government measures such as the index of government response and economic support. These indexes have significant impact on inflation and exchange rate. In fact, economic support index shows an increasing impact on inflation (0.72%) reflecting the impact of the imbalance between the offer and the demand and the special short-term policy of the Central Bank to maintain the inflation rate in crisis periods and thus validates our model for further analysis. Our findings are verified by Barro et al. (2020) who proved the positive impact on inflation. On the other hand, our findings prove that the government response significantly decreases the exchange rate (6.58%). Our results are in line with Bodenstein et al. (2020) and Ozili (2020) and Basilaia and Kvavadze (2020). These facts could be explained in part by the adverse effect of social distancing on economic activity. Our findings hold even for the interaction variable CAS×GOVR allowing us to improve the robustness of our results with an increasing effect for inflation (8.99%) and a decreasing effect for exchange rate (7.95%). We conclude that the reducing effect of COVID-19 is balanced by the positive effect of government measures on inflation.

In the third model, we note that containment and health index have significant and positive impact (1.68%) and since economic support measure has a positive impact (0.72%), we can conclude that overall inflation reacted positively to these government actions. However, the result of school closing is not statistically significant which is confirmed by Correia et al. (2020). Therefore, inflation reaction, though positive, is not very strong. On the contrary, inflation might have reacted more

strongly and negatively to the stock index (−0.71%) and the lending rate (3.94%) and positively to exchange rate (0.08%) since the announcement of the worldwide pandemic. Latin American currencies, poorly diversified in the global economic market, lose value as the economic outlook deteriorates. And yet, for sanitary measures, the ban on Chinese nationals traveling abroad has helped to partially reduce China's trade deficit in services. The decline in outflows, tourism-related capital flows, supported the currency, while damaging the Thai, South Korean, and Singaporean currencies whose economies depend on Chinese tourism. The Japanese yen fell 3% in the first weeks of February. This phenomenon is partly due to concerns about the global pandemic since Japan, just after China, has recorded the highest number of cases of COVID-19 contamination. Japan's economy has been directly affected by the disruption of flows with its largest trading partner, China. The country is also the top destination for most Chinese tourists, yet according to the Japanese tourism board, more than 400,000 Chinese have canceled their vacations in Japan until the end of March. The yen was also penalized due to the deterioration of the Japanese economy prompting the currency world to anticipate the possible collapse of the currency.

We include a fourth model to account for economic indicators like production and unemployment, we find significant negative impact of production on inflation (−8.51%) and no effect for unemployment. Besides, we find that both production and unemployment measures have respectively significant and negative effect on the exchange rate (−1.2%) and (−0.98%). This is explained by the effect of the shock of supply and demand in the market and its negative consequences on international trade in goods and services. These tensions in the goods and services market and the foreign exchange market lead to lower purchasing power and inflation and subsequently worsening poverty. These results are confirmed with the study by Baldwin and Tomiura (2020) who estimated that this virus carries health and economic contagion effects. Also, the containment measures have led to an increase in unemployment and absenteeism and consequently a drop in income, a drop in consumption, a drop in tax revenues, a drop in production, and the real cost of labor is therefore increased, which induces an increase in equilibrium unemployment, consequently, a depreciation of the exchange rate. These results are confirmed by McKibbin and Fernando (2020).

Conclusion

This paper studies the effect of COVID-19 and government measures on economic indicators in Latin America and Asian countries over the period January to September 2020. The expected economic impact of government actions, such as government policy announcements regarding public awareness and economic support on inflation and exchange rate are examined. The empirical analysis is based on generalized method of moments.

The results reveal that the government measures have dual impact on the economic indicators. In fact, while these measures are accompanied by a significant increase in inflation, they significantly decrease the exchange rate. Beside, the

increase in the number of confirmed cases leads to higher inflation and a lower exchange rate due to an increase in demand relative to supply.

Therefore, mitigating the pandemic may prevent an economic recession or make the situation worse. Fear of financial and economic collapse has led to increased demand, accumulation of foreign currency by individuals and businesses. On the other hand, government actions can be effective in reducing new infections, if short run government interventions become permanent by investing in health infrastructure and improving the national health system to resist the epidemics and contagious diseases.

Tackling inequalities must be at the heart of both short-term stimulus measures and long-term policy changes and measures to build back better. First, policies could prioritize reducing inequalities in income, wealth, and access to basic services and social protection what needs to be scaled up investments to strengthen health systems in the two sub-regions and accelerate progress towards universal health coverage. Second, it is also necessary to initiate short- and long-term measures that meet the needs of vulnerable groups. Prioritize bridging the digital divide in Southeast Asia. Third, coordinated and strengthened regional action and funding mechanisms are needed to achieve next-generation infrastructure networks in Asia and Latin countries. In terms of policies, we also recommend easing credit to allow households to smooth their consumption and businesses to survive the immediate shock. However, given the risk of a protracted crisis, we stress the need to couple these measures with regulatory oversight, especially as corporate and household debts are already high in many countries in the region. For poorer countries, debt relief will be necessary, so that essential resources can be devoted to managing the economic and health consequences of the pandemic.

A number of emerging market economies with exchange rate frameworks and manageable exposures to foreign currency-denominated debt, including Brazil, India, and Mexico, have the opportunity to further ease their monetary policy by case of falling inflation, while taking the opportunity to take fiscal and structural measures that strengthen investor confidence.

Budget support must be reinforced by greater public investment. The additional uncertainty associated with the coronavirus outbreak makes it essential that monetary policies remain favorable in all economies to ensure that long-term interest rates remain low.

A number of emerging market economies with flexible exchange rate frameworks and manageable exposures to foreign currency-denominated debt, including Brazil, India, and Mexico, have the opportunity to further ease their monetary policy in the event of a fall in inflation, while taking the opportunity to take fiscal and structural measures that will strengthen investor confidence. Budget support must be reinforced by greater public investment.

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