


Impact of COVID-19 on Pakistan's economic development: A sector-wise analysis

American Journal of Social Sciences and Humanities

Vol. 8, No. 1, 73-88, 2023

e-ISSN: 2520-5382



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ABSTRACT

The recent COVID-19 pandemic has significantly hampered economic development. The ongoing pandemic has posed challenges to economies and altered global lifestyles, with people mostly staying at home and working from home if possible. As a result, the development of various sectors of the economy is impacted significantly. The present study aims to scrutinize the impact of COVID-19 on Pakistan's economy focusing on the three main sectors such as services, industrial, and agriculture. The Gross National Product (GNP) of the respective sector is used to measure economic development, and COVID-19 is proxied through total coronavirus cases and the number of infected people (active cases). The data covered in the study range from 2020M2 to 2022M4. The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests are used to ensure that the variables are stationary at the level. The empirical investigation is carried out by employing the Ordinary Least Square (OLS) method. The findings reveal that both the proxies of COVID-19 have a negative and significant impact on all sectors, however, the size differs depending on the nature of these sectors. As such, the impact on the service and industrial sectors is larger than the impact on agriculture. The findings imply that Pakistani ministries should work cooperatively to align the development policies in the aftermath of COVID-19 to improve sectoral development and in turn the overall development of the economy.

Keywords: *Agriculture, CoV infection, COVID-19, Industry, OLS, Pakistan, Sectoral development, Service, Trade.*

DOI: 10.55284/ajssh.v8i1.872

Citation | Mazhar, M. (2023). Impact of COVID-19 on Pakistan's economic development: A sector-wise analysis. *American Journal of Social Sciences and Humanities*, 8(1), 73-88.

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Funding: This study received no specific financial support.

Competing Interests: The author declares that there are no conflicts of interests regarding the publication of this paper.

History: Received: 21 November 2022/ Revised: 12 January 2023/ Accepted: 30 January 2023/ Published: 22 February 2023

Publisher: Online Science Publishing

Highlights of this paper

- This study aims to investigate the impact of COVID-19 on the sectoral development of Pakistan.
- The analysis is performed for three sectors namely agriculture, industrial, and Service.
- The findings reveal that the pandemic has a negative impact on all sector however impact differ based on sectoral' absorption capacity.

1. INTRODUCTION

Infectious illnesses are ailments caused by tiny organisms such as bacteria, viruses, fungi, or parasites that can be transmitted from person to person. It can be transmitted directly by body fluids and aerosols (from coughing and sneezing), as well as indirectly via interaction with an infectious animal possessing a pathogenic bacteria that can infect living beings. Despite considerable breakthroughs in the healthcare industry, infectious disease transmissions is increasing as a result of greater industrialization, globalization, improved transportation, urbanization, congested cities, behavioral changes, resurgent microorganisms, and inaccurate antibiotic use. These illnesses are now one of the leading causes of mortality globally, accounting for one-quarter to one-third of all fatalities (Vendrell-Herrero, Darko, & Vaillant, 2022).

COVID-19, a recently reported infectious illness, emerged as the greatest cause of mortality in 2020. The World Health Organization (WHO) labeled it a global health emergency in January 2020, and the virus was legally certified as a pandemic on March 11, the highest category of a health emergency. The pandemic has demonstrated how quickly infectious illnesses may spread in open markets, endangering countries' economic stability by preparing hospital facilities, isolating sick individuals, and tracking contacts. All of this has put additional strain on public health resources (due to high demand for consumables such as antibiotics, medical supplies, and personal protective equipment), human resources, and other expenditures. COVID-19 has wreaked havoc on economies throughout the world, with both short-term budgetary and long-term economic consequences (Shang, Li, & Zhang, 2021).

The World Bank (2022a) claimed in its most recent report that in 2020, countries experienced a 90 % decline in economic activity, the global economy shrunk by around 3%, and poverty levels climbed for the first time in a generation. The situation in Pakistan is comparable to that of other developing countries because its economy was already weak, as evidenced by its weak "macroeconomic indicators" and "low compliance with International Monetary Fund (IMF) conditionalities." The pandemic breakout has been a further shock, lowering Pakistan's anticipated Gross Domestic Product (GDP) growth in 2020 to (-) 0.38% (UNIDO, 2021). It has affected every sector of the economy and had a profoundly negative impact on it. The manufacturing industry, notably the exporters, experienced challenges due to the declining demand for imported goods from Pakistan and other developing nations. The Manufacturing sector, which accounts for 65.0% of the industry, has a greater impact on the success of the industrial sector. Large-Scale Manufacturing (LSM) accounts for 74% of all manufacturing, but currently, only has a 48% industry share.

The Quantum Index Numbers (QIM) index decreased as a result of COVID-19 by 32.7 % Month on Month (MoM) in March 2020 and by 41.6 % Year on Year (YoY) in April 2020, when it hit its lowest point of 85.6. Almost every subsector, including automobiles (-36.50%), Wood Products (-22.11%), coke and petroleum products (-17.46%), electronics (-13.54%), engineering products (-7.05%), textiles (-2.57%) and food, beverage, and tobacco (-2.33%), saw a considerable fall in FY2020. The performance of small-scale industries also declines from 8.20 % to 1.52 %, given the national lockdown scenario (GoP, 2020). Following the lockdown ending and the government's effective policy adjustments, the sector gradually recovered in the later years. By FY2021 and FY2022 (July – March) the sector grew by 7.2 % and 7.8 % with QIM by 9.3 % and 10.4 %, respectively. Wood Products (157.5%), Automobiles (54.1%),

Chemicals (7.8%), Tobacco (16.7%), Food (11.7%), and other manufacturing remain the major contributors to the expansion in 2022 (GoP, 2022).

The largest sector of the economy, the services sector, was hardest hit by the current crisis and experienced a provisional decline of 0.59 % in FY2020. Numerous enterprises in the services industry, including hotels, restaurants, wedding venues, and marquees, have closed as a result of “social distancing”. In a similar vein, aside from the transportation sector, wholesale and retail commerce was the services sector that was most negatively impacted by border restrictions and the general downturn in activity. The wholesale and retail trade sector and transport, storage, and communication sector see a decline of 3.42 % and 7.13 % while others experienced a rise (GoP, 2020). The recovery has been observed in the later years as the sector grew by 6.0 % (in Fiscal Year (FY) 2021) and 6.2 % (in FY2022), respectively. Majorly, the growth in the wholesale and retail trade sector is recorded as 8.4 % in FY2021 (GoP, 2021) and 10.0 % in FY2022 (GoP, 2022).

According to the GoP (2020) COVID-19 had no appreciable effects on the agriculture industry, which grew by 2.67 %. Important crops saw positive growth of 2.90 % as a result of the higher output of wheat, rice, and maize, which increased by 2.45 %, 2.89 %, and 6.01 %, respectively. The livestock, forestry, and fishing industry have also increased by 2.58 %, 2.29 %, and 0.60 %, respectively. Sugarcane, cotton, and cotton ginning all, experience declines in the growth of 6.92 %, 0.44 %, and 4.61 %, respectively. Due to market closures or decreased market activity, the overall incomes of producers of animal products, brokers working in Agri-based companies, and employees in the agricultural and non-agricultural sectors have also decreased. The poultry sector, which has suffered large declines in both pricing for poultry, has been the most affected by the COVID-19 response. Both the market forces for cattle products declined as a result of reduced demand, logistics issues, and transportation limitations (GoP, 2020). The industry continued to strengthen in 2022 as the agriculture sector experienced a 4.4 % gain, primarily due to 6.6 % growth in crops and 3.3 % growth in livestock (GoP, 2022).

Pakistan fared much better in combating the virus than many other countries. The majority of the key industries are recovering. The economy has had a V-shaped recovery. Without jeopardizing internal and external stability, the current economic recovery was accomplished. Because, several crucial policy decisions were made by the government, including financial and economic measures, small lockdowns, quick vaccination, etc. The provinces and the National Command and Operating Centre (NCOC) have been tasked with working together to make major decisions. Due to the government’s quick action, the situation was stabilized (GoP, 2022). According to the statistics, the economy’s sectors are hit hard by the current crisis but no empirical study is done so far on this matter targeting these three main sectors.

The present study aims to answer the following questions (i) Is COVID-19 have any impact on agriculture sector development? If so, is it then favorable or unfavorable (ii) Does COVID-19 affect the growth of the industrial sector in any way? If so, is it then favorable or unfavorable? (iii) Does COVID-19 have any effect on the growth of the service sector? If so, is it then favorable or unfavorable? (iv) Do all sectors experience the same impact? (v) Is there a similar impact of the number of active cases and total coronavirus cases? (vi) What is the impact of international trade on sectoral GNP in the presence of coronavirus? The answers to these questions will have important policy implications for Pakistani policymakers in terms of maintaining sectoral growth in the aftermath and alongside the COVID-19 crisis, as COVID-19 is a type of microorganism that is constantly evolving and becoming resistant to antibacterial treatments, posing a constant and ongoing risk, and that outbreaks reoccur as so far certain waves, as well as new variants such as Delta virus and Omicron, are observed.

The contribution of the study is multifold. To the best of my knowledge, this is the first study to provide an empirical analysis of COVID-19 and economic development through the lens of three major sectors namely

agriculture, industrial, and service sectors. Second, this study incorporates two coronavirus measures to obtain a clearer picture of the relationship between the variables in question. Third, this study investigates the impact of international trade on sectoral GNP during the pandemic crisis. Fourth, the empirical analysis in this study is based on the maximum available data from 2020M2 to 2022M4. Finally, this study considers the impact of trade during the specified period in light of the current COVID-19 shock.

The remainder of the paper is structured as follows: Section 2 contains a review of the literature, Section 3 discusses the data and methodology, Section 4 discusses the empirical findings, and Section 5 concludes the study with some policy implications.

2. LITERATURE REVIEW

2.1. SARS and Economic Impacts: Evidence from World Economies

COVID-19 is a global public health emergency caused by infection with “severe acute respiratory syndrome coronavirus 2” (SARS-CoV-2). The SARS-associated coronavirus causes the severe acute respiratory syndrome, a viral respiratory illness (SARS). It was discovered (now known as SARS-CoV-1) at the end of February 2003 as part of an outbreak that started in China (in Foshan near Guangzhou province) and spread to some other countries. It was the first serious and easily transmitted new illness to emerge in the twenty-first century, with a clear proclivity to spread along international air travel routes (WHO, 2022). According to the literature, the virus has caused significant economic disruptions by reducing domestic and international travel (leisure, business, etc.), restaurants, retailers, and taxi companies’ day-to-day operations.

According to Xu (2003) fear of infection caused significant economic losses in the country during the virus’s initial phase. Because people canceled their travel plans and cut back on “dining out and shopping.” As a result, the initial economic impact of SARS was borne primarily by service businesses, which are the most reliant on consumer spending and thus the most vulnerable to a sharp decline in consumer confidence. The tourism, entertainment, retail, and catering industries have suffered the most, putting a damper on China’s economic growth. For assessing the economic consequences of SARS, Lee and McKibbin (2004) used the global model/G-Cubed (Asia-Pacific). They discovered that SARS reduces the number of workdays, which reduces income. Along with this, epidemics have a significant detrimental influence on the population and workforce. The diseases also have a significant impact on demographic structure via households’ fertility decisions and in turn on the long-term economic growth. The “human capital” or “health capital” declines because of negative shocks from epidemics, which diminish worker life expectancy, productivity, and so economic growth. The uncertainty generated by epidemics causes further economic losses in terms of low investment and economic growth because of a lack of trust in future profitability.

Hai, Zhao, Wang, and Hou (2004) attempted to study the SARS’s short-term economic impact on the Chinese economy. They discovered meaningful information about the epidemic’s consequences, particularly on the country’s service sector, through a survey held in Beijing. According to them, the epidemics had a significant impact on the tourism industry, with the country’s tourism revenues dropping by 70 to 80 percent (about 16.8 billion US dollars) by the end of 2003. With a low growth rate, the economy has lost a total of 25.3 billion US dollars. In addition, Siu and Wong (2004) affirm a strong negative influence of SARS on economic growth for the Hong Kong economy, and Hanna and Huang (2004); Lee and McKibbin (2004) on Asian economies. They stated that the epidemics alter individual investment and consumption behavior, resulting in low investment (due to increased risk of business costs), low consumption (because of income loss), and low travel and tourist services.

Lee and Warner (2006) investigate the impact of SARS on human resource management (HRM), employment levels, and labor markets in Singapore’s hotel industry. They used a two-pronged process that included the

establishment of a SARS information database and interviews with key industry decision-makers. Their findings reveal that epidemics have a significant detrimental impact on HRM in the hotel business due to both supply and demand shocks. Because epidemics produce “supply shocks” that diminish workfare due to illness, business closer, reduced productivity, and so on, as well as “demand shocks” caused by people’s decisions to consume less (shopping less) and make dubious economic judgments.

Considering the Taiwan economy case, [Chen, Jang, and Kim \(2007\)](#) used an “event-study methodology (ESM)” to investigate the influence of the SARS epidemic on the stock prices of Taiwan’s hotel business. The sample comprises eight firms, six of which have stock on the Taiwan stock exchange and two of which have shares on the over-the-counter market. They demonstrate that SARS has a significant negative impact on the country’s economy by putting great pressure on the tourist industry, and therefore on hotels, restaurants, amusement parks, and airlines. As a result, the tourist industry had the greatest decrease in income and total stock values during the SARS epidemic, with negative cumulative mean abnormal returns.

[Keogh-Brown and Smith \(2008\)](#) conducted a retrospective study to examine the economic impact of SARS in countries where cases have been reported. The researchers determined that the epidemic have a disastrous effect on the global economy. The scale of the SARS impact on impacted nations is, however, substantially smaller than portrayed in contemporary media reports. Further, with a similar objective, [Yang and Chen \(2009\)](#) built a “computable general equilibrium model with tourism and travel activities.” They used data from Taiwan’s consistent social accounting matrix (SAM) to do this. Their study indicated that the decrease in incoming tourist consumption negatively and significantly affected Taiwan’s GDP and employment level. Further, [Chen, Chen, Tang, and Huang \(2009\)](#) for Taiwan’s industries show the asymmetrical impacts of SARS using the daily closing stock prices data of concerned enterprises. According to their findings, the SARS crisis has a significant detrimental impact on the tourism, wholesale and retail sectors while having a beneficial influence on the biotechnology sector (due to the high demand for biotechnology sector products i.e. respirator masks such as N95).

2.2. COVID-19 and Economic Impacts: Evidence from World Economies

COVID-19 (induced by SARS-CoV-2) has far-reaching economic repercussions, in contrast to SARS-CoV-1, for a variety of reasons. It is more communicable, its effects are more intense and stimulating, and its ability to remain on surfaces makes it more difficult to control. It is more contagious than influenza and swine flu because it spreads more easily between people. The delay in finding and approving therapeutic medications since the first infection causes considerable death and economic harm. Importantly, germs are a continuous and recurring concern due to their continual growth and resistance to antibacterial treatments. The majority of outbreaks reoccur, and the present COVID-19 pandemic might change and repeat itself ([Shang et al., 2021](#)). As the new variants are also observed namely Omicron, Delta, Alpha, and others.

The pandemic, therefore, has had a substantial impact on both the global and domestic economic systems. The pandemic affects all aspects of the economy, including global financial markets, social welfare, and economic development. To battle the lethal sickness and avoid additional damage to economies and credit markets, public and private policymakers enacted several strategies including complete and smart lockdowns, suspension of public gatherings, face coverings, and fiscal and monetary mechanisms ([Phan & Narayan, 2020](#)). Scientists and medical experts worked diligently to develop COVID-19 vaccines with the assistance of public and private organizations. Similarly, academic experts analyze the economic repercussions of the pandemic to give greater policy support to authorities to control the pandemic’s disastrous impact.

In this regard, [Dhar \(2020\)](#) contends that the COVID-19 crisis has had a bigger influence on the Chinese economy. More than 18 million small and medium-sized businesses in the country have suffered significant losses as a result of higher business costs, increased inventory costs, output loss, capital loss, and bank failure. Using Worldometer data, [Ozili and Arun \(2020\)](#) determined that COVID-19 created unexpected economic disruptions that have a large impact on the global economy through demand and supply shocks. The imposition of lockdown, monetary and fiscal policy decisions and travel restrictions all had a substantial impact on economic activity and stock values. As the number of coronavirus infections and deaths increased, so did the inflation rate, worldwide unemployment, and the global energy commodities index. According to [Gupta et al. \(2020\)](#) the COVID crisis had a severe negative impact on the global economy and financial system. Furthermore, the current epidemic has wreaked havoc on global social, economic, health, and environmental systems ([Gautam & Hens, 2020](#)).

The COVID crisis triggered a global economic downturn. The crisis has serious negative consequences for employees, consumers, supply chain management, credit markets, and the economy's development. However, the total length and size of this shrinkage are unexpected given the uncertainty of the pandemic's ending period [Açikgöz and Günay \(2020\)](#). With the extended national lockdown, the global economic slump, and the resulting disruption of demand and supply networks, the economy of India has seen a significant drop in economic activity and, as a result, economic growth ([Dev & Sengupta, 2020](#)). According to [Susilawati, Falefi, and Purwoko \(2020\)](#) the increase in coronavirus incidence has generated economic stability concerns for the Indonesian economy. Using secondary data from a variety of sources (government official information, official internet sites, and so on), the authors found that the pandemic has had a detrimental impact on all sectors of the economy, particularly tourism, transportation, health, and commerce.

[Bagchi, Chatterjee, Ghosh, and Dandapat \(2020\)](#) claimed that COVID-19-induced uncertainty in output and oil prices caused a collapse in stock indices and supply chain management. Overall, it is the most dangerous to the global economy since the great recession of 2008-2009. [Albu et al. \(2020\)](#) utilized a unique form of a logistic model to assess the pandemic effects. They examine three scenarios: worldwide, European Union, and Romania. All the estimates show that COVID-19 slowed down the growth process and a decline in GDP is observed in all scenarios. Further, by using the data from different secondary sources [Grima, Dalli Gonzi, and Thalassinou \(2020\)](#) have asserted that the pandemic has affected every sphere of the economies. It has also caused significant harm to the Maltese economy in terms of changes in economic decisions, investment, and GDP. [Thorbecke \(2020\)](#) investigated the influence of COVID-19 on the stock returns of 125 industries in the context of the US economy. Idiosyncratic characteristics, according to the data, affected businesses such as airlines, aircraft, real estate, tourism, oil, breweries, retail clothes, and funerals. Losses were caused by macroeconomic variables in industries such as industrial equipment, machinery, and electronic and electrical equipment as a result of negative pandemic shocks.

According to [Priya, Cuce, and Sudhakar \(2021\)](#) during the pandemic when more than 80% of individuals are socially isolated in their homes, the momentary disruption in the production network reduces energy usage globally. The virus, therefore, emerged as a big threat to crude oil prices. With a sharp decline in energy demand, rise in essential commodity prices, low freight transport, railways, and oil supply the prices of crude oil fell in the early days of the pandemic. [Beckman and Countryman \(2021\)](#) concentrated on food away from home (FAFH) and the influence of COVID-19 on agricultural production and trade. According to their findings, the virus had a significant impact on agriculture during the early days of the pandemic, causing disruptions in the US economy. However, the non-agriculture shocks exceed the effects. The contribution of FAFH, in particular, remains strong, causing large changes in GDP.

According to [Mohsin, Hongzhen, and Hossain \(2021\)](#) COVID-19 causes severe harm to main macroeconomic indices. For example, it resulted in lower consumption and investment, price fluctuations, and a tightening of export and import. [Kumar, Alshazly, Idris, and Bourouis \(2021\)](#) provided a similar conclusion. According to their research, the pandemic has had an impact on nearly every area of the economy. It has had a detrimental impact on the global economy's business, entertainment, agriculture, manufacturing, tourism, globalization, and service sectors. The environmental quality improved due to less economic activity and a reduction in pollutants in the air, water, and soil. According to [Habibi, Habibi, and Mohammadi \(2022\)](#) the current pandemic has had a significant detrimental influence on the Chinese economy in terms of increased unemployment (particularly in tourism and transport), less investment, production, and disruption of the supply and demand process. [Yetkin Özbük, Coşkun, and Filimonau \(2022\)](#) further pointed out the pandemic has changed the food management behavior of households that differs based on careless and resourceful planner consumers.

2.3. COVID-19 and Economic Impacts: Evidence from Pakistan's Economy

Pakistan is classified as a developing country with few resources. The government is battling COVID-19 with little resources, and the country's unstable economy is a key problem. According to [Akram \(2020\)](#) Pakistan has strong contact with China and Iran (both countries have religious ties), and the number of travelers to these countries is higher, posing a significant danger of coronavirus transmission to the country with a shaky economy. Pakistan implemented policies such as "lockdown, stay-at-home, social isolation, cancellation of international flights and high-quality healthcare care" which have had a detrimental and significant impact on the economy. These early preventative actions of the government, however, helped to reduce the pandemic's peak and the number of infections in the country. State officials handled the coronavirus pandemic by adopting preemptive precautionary measures to ensure the safety of the residents and mitigate severe economic damage ([Akram & Meo, 2020](#)).

[Khan, Ali, and Aftab \(2020\)](#) argued that the present crisis has had a detrimental impact on the Pakistan stock exchange, and a steady decline was noticed during the early days of the pandemic. The liquidity shortfall in the manufacturing sector, as well as rising prices and unemployment, have all had a detrimental impact on other macroeconomic indices. Using the mixed-method approach [Shaheen, Siraj, and Bhatti \(2020\)](#) show that deficient health services and a lesser coordinated response, along with a significant loss in GDP, cause the post-pandemic state more demanding and time-consuming. [Asghar, Batool, Farooq, and ur Rehman \(2020\)](#) claimed the pandemic had a detrimental impact on the Pakistani economy by lowering exports, remittances, and commerce. To summarize, the pandemic triggered demand and supply shocks that harmed every area of the economy.

[Shafi, Liu, and Ren \(2020\)](#) used a snowball sampling strategy to gather data from 184 micro, small, and medium firms (using online mode) from April 9 to April 21, 2020. Along with this, the authors used an exploratory approach to attain the research goal. Their study reveals that COVID-19 poses significant hurdles to most businesses, including financial, supply chain disruption, lower demand, decreased sales, and profit, and so on. As per [Salik and Rafique \(2020\)](#) Pakistan's economy is expected to lose up to 4% of its GDP because of interruptions in trade, probable declines in FDI and remittances, and flows in other industries such as flying, hospitality, and tourism triggered by the nation's lockdown. The devastating economic consequences are already visible, with broad lockdowns halting most routine operations, export orders canceled, and large numbers of daily workers unexpectedly laid off.

[Rasheed, Rizwan, Javed, Sharif, and Zaidi \(2021\)](#) evaluated COVID-19's socioeconomic and environmental effects. According to their calculations, Pakistan's GDP will lose 10% (approximately 1.1 trillion Pakistani Rupee (PKR)) in FY2021. The closure and other travel restrictions have had an impact on 7.15 million employees' livelihoods, and poverty is predicted to rise to 33.7%. In addition to the primary, secondary, and tertiary sectors, the

health care, education, and supply chain systems were badly disrupted. However, as a result of fewer industrial and other economic activities, air quality has improved. Similarly, [Abbass et al. \(2022\)](#) found, using a Keynesian approach that the drop in aggregated demand caused by COVID-19 has resulted in low production, investment, employment, and economic growth in Pakistan. Unemployment is roughly 25 million people, pushing many into poverty as the significant economic impact in numerous industries is expected to be approximately PKR 1.3 trillion. Tourism and travel, financial markets, entertainment, manufacturing, and other industries have been particularly heavily hit, with a disastrous effect on GDP. It is mostly wage employees and small company owners that have been severely exploited and forced into a curfew-like scenario. Further, using the government official data [Ahmed, Naz, and Haider \(2022\)](#) concluded that Pakistan's GDP fall drastically as a result of pandemic negative shocks.

In conclusion, the literature review reveals that infectious disorders have a detrimental impact on human health, personal growth, economic decisions, investment, productivity, consumption patterns, travel and tourism, and, as a result, economic development (see [Figure 1](#)). The epidemic and pandemic not only damage a specific location, but they also extend throughout the global economy and have a spillover effect owing to nations' international economic links. Hence, unlike SARS-CoV-1, COVID-19 produces significant economic, social, and other disruptions and threatens world economies, including Pakistan. So far, the study on the impact of COVID-19 on economies has been primarily exploratory and descriptive. The current paper contributes to the literature by providing a scientific analysis of COVID-19's influence on Pakistan's three primary sectors: agriculture, industry, and service. The study spans the longest time period available, from 2020M2 to 2022M4, and employs the least square approach for empirical analysis.

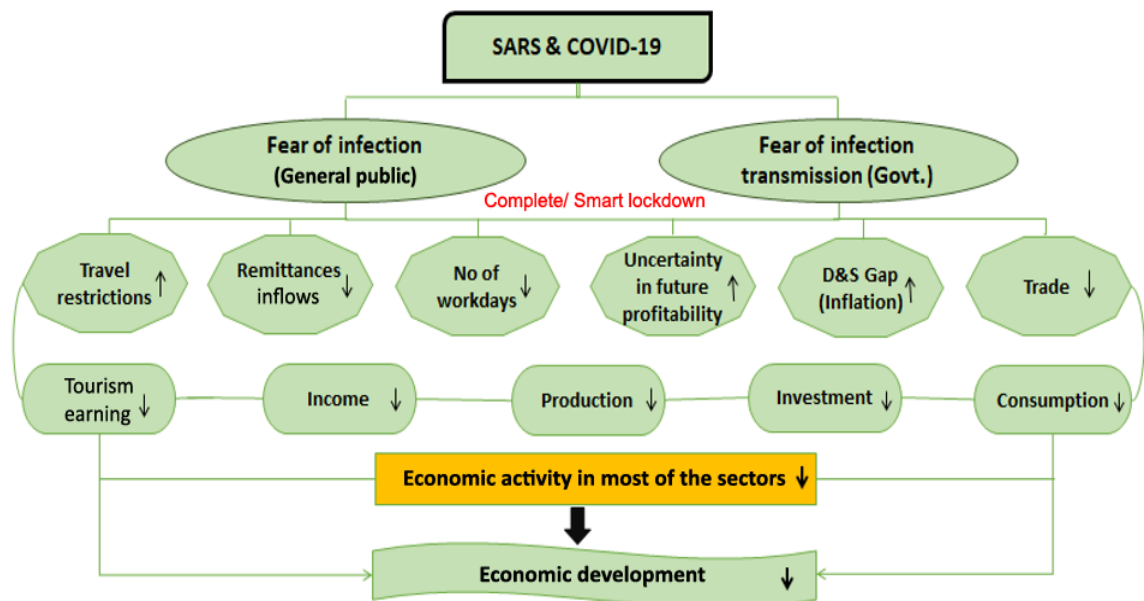


Figure 1. Relationship between COVID-19 and economic development.

3. DATA AND METHODOLOGY

The goal of this research is to look into the COVID-19 sectoral development aspects for the Pakistani economy. The empirical study makes use of data from the [PES \(2022\)](#); [World Bank \(2022b\)](#) and [Worldometer \(2022\)](#) spanning the years 2020M2 to 2022M4. The data of COVID-19 proxies total coronavirus and active cases were available in monthly frequency while trade and energy consumption was available in annual frequency, which is transformed to monthly using the statistical package Eviews 12. The study's econometric model is structured following previous literature on growth and development:

$$LAGNP_t = \beta_0 + \beta_1 LCOVID_t + \beta_2 LTR_t + \beta_3 LEC_t + \mu_t \tag{1}$$

$$LIGNP_t = \beta_0 + \beta_1 LCOVID_t + \beta_2 LTR_t + \beta_3 LEC_t + \mu_t \tag{2}$$

$$LSGNP_t = \beta_0 + \beta_1 LCOVID_t + \beta_2 LTR_t + \beta_3 LEC_t + \mu_t \tag{3}$$

Where, left-hand side variables LAGNP, LIGNP, and LSGNP are the dependent variables while right-hand side variables namely LCOVID, LTR, and LEC are the independent variables of the study. LAGNP is the gross national product of the agriculture sector measured in constant basic prices of 2005-06. LIGNP is the gross national product of the industrial sector measured in constant basic prices of 2005-06. LSGNP is the gross national product of the service sector measured in constant basic prices of 2005-06. LCOVID is indicating the log of COVID indicator proxies by total coronavirus cases (TCC) and the number of infected people (active cases) (CAC). LTR is the log of trade measured as a percentage of GDP. LEC is the energy consumption of oil/petroleum in tons used in households, industry, agriculture, transport, power, and other sectors.

The stationarity of the variables is first tested for regression analysis using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests. Dickey and Fuller (1981) ADF test is an expanded version of the Dickey-Fuller test that includes a more sophisticated higher-order autoregressive (AR) process. The test’s null hypothesis is “there is a unit root in the AR model”, meaning that the series is not stationary. The other hypothesis is that the series is stationary. Phillips and Perron (1988) devised the PP test, which yields largely the same results as the ADF. The main distinction is that the PP test ignores serial correlation, whereas ADF approximates the structure of errors using parametric autoregression.

Based on the variable stationery the simple Ordinary Least Square (OLS) method is employed. It is the most popular estimation technique for estimating the parameters in a linear regression model. It provides the most accurate estimates as long as the model complies with the OLS assumptions for linear regression such as no errors are homoscedastic, serially uncorrelated, and the regressors are exogenous. When the errors have finite variances, the OLS method provides a “minimum-variance mean-unbiased” estimate. OLS is the maximum likelihood estimator under the additional presumption that the errors are normally distributed. The methodological way forward diagram is presented in Figure 2.

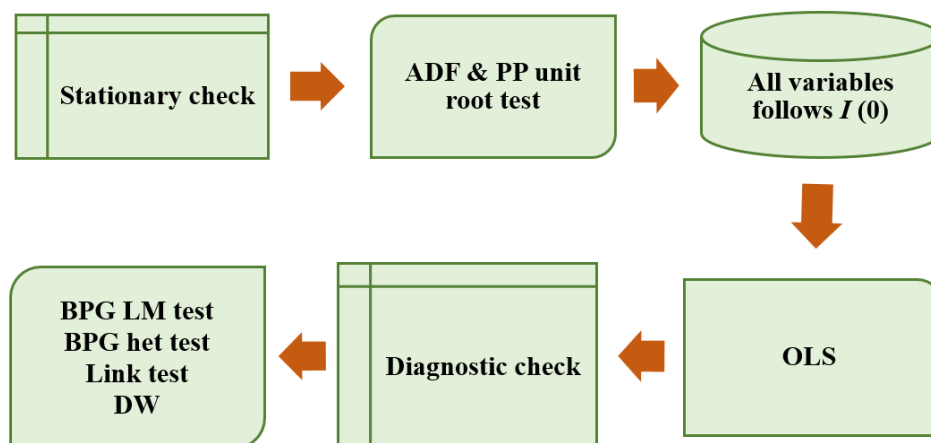


Figure 2. Empirical methodology.

4. RESULTS AND DISCUSSION

4.1. Summary Statistics

The summary statistics for the variables used in the analysis are shown in Table 1. According to statistics, the average GNP of the agricultural sector is 1.561 million US dollars, the industrial sector is million 1.552 US dollars,

and the service sector is 4.993 US dollars. During the COVID-19 period, the service sector had the highest GNP, followed by agriculture and the industrial sector. Because, although service was most affected the recovery after lockdown removal and the Information Technology (IT) service expansion played a great role in it. All the sectors' GNP goes down about -0.625 (agriculture), -0.623 (industrial), and -2.010 (service), and the maximum GNP remains about 2.502 million US Dollars for agriculture, 2.493 million US Dollars for the industrial, and 8.041 for the service sector. During the study period, the country reported 523988.3 TCC and 31471.8 CAC on average.

Table 1. Summary statistics.

Variable	Obs.	Mean	Std. dev.	Min	Max
AGNP	27	1.561	1.075	-0.625	2.502
IGNP	27	1.552	1.067	-0.623	2.493
SGNP	27	4.993	3.432	-2.010	8.041
TCC	27	74590	523988.3	4	1528412
CAC	27	36645.3	31471.8	4	106361
TR	27	-4.579	18.175	-34.348	25.188
EC	27	13107568.7	1567818.4	11506030	14575646

Note: AGNP=Agriculture sector gross national product, IGNP=Industrial sector gross national product SGNP=Service sector gross national product, TCC= Total coronavirus cases, CAC= Coronavirus active cases, TR=Trade, and EC=Energy consumption.

4.2. Correlation Matrix

Table 2 shows the correlation matrix for all of the models used in this study. The TCC is negatively and highly correlated with the sectors' GNP (all sectors) while CAC has a minimum correlation with the sectoral GNP. TR and EC also have a high correlation with the agriculture, industrial, and service sector GNP implying a strong relation between trade, energy consumption, and sectoral income.

Table 2. Correlation matrix.

Variables	Model using TCC				Model using CAC			
	AGNPI	COVID	TR	EC	AGNP	COVID	TRI	EC
	Model 1				Model 4			
AGNP	1				1			
COVID	-0.919	1			-0.094	1		
TR	0.883	-0.990	1		0.883	-0.232	1	
EC	0.985	-0.842	0.792	1	0.985	-0.039	0.792	1
	Model 2				Model 5			
IGNP	1				1			
COVID	-0.916	1			-0.092	1		
TR	0.880	-0.990	1		0.880	-0.232	1	
EC	0.986	-0.842	0.792	1	0.986	-0.039	0.792	1
	Model 3				Model 6			
SGNP	1				1			
COVID	-0.913	1			-0.09	1		
TR	0.877	-0.990	1		0.877	-0.232	1	
EC	0.987	-0.842	0.792	1	0.987	-0.039	0.792	1

Note: AGNP=Agriculture sector gross national product, IGNP=Industrial sector gross national product SGNP=Service sector gross national product, TCC= Total coronavirus cases, CAC= Coronavirus active cases, TR=Trade, and EC=Energy consumption.

4.3. Results of Unit Root Tests

The results of unit root testing are shown in Table 3. The ADF and PP tests are applied to all of the variables in the study. The test statistics for all the variables are significant at the 1 % and 5% levels of significance at the level, showing that all the series are stationary at the level. As a result, the order of integration of all variables is I (0).

Table 3. Results of unit root tests.

Tests	ADF test	PP test	Order of integration
Variables	Null hypothesis: Series contains a unit root		
	At level	At level	
LAGNP	-2.835***	-2.238**	I (0)
LIGNP	-2.823***	-2.228**	I (0)
LSGNP	-2.827***	-2.230**	I (0)
LTCC	-4.667***	-17.28***	I (0)
LCAC	-6.979***	-7.385***	I (0)
LTR	-8.923***	-2.314**	I (0)
LEC	-2.551**	-2.006**	I (0)

Note: ***, ** indicates significance level at 1 %, and 5 %, respectively. Vales are test statistics Z (t).
 AGNP=Agriculture sector gross national product, IGNP=Industrial sector gross national product
 SGNP=Service sector gross national product, TCC= Total Coronavirus cases, CAC= Coronavirus
 active cases, TR=Trade, and EC=Energy consumption.

4.4. Regression Results (OLS)

Table 4 displays the least squares results, with columns 1-3 representing TCC findings and columns 4-6 representing CAC findings. In this case, a 1% rise in TCC is associated with a 0.00004 % fall in agriculture, 0.00005 % decrease in industrial, and 0.00006 % fall in sector GNP, respectively. With a 1% level of significance, the coefficients remain highly significant across all sectors. In terms of CAC, a 1% increase in CAC results in a 0.00002 %, 0.00003 %, and 0.00004 % decrease in agriculture, industrial, and service sectors' GNP, respectively. These findings are supported by Beckman and Countryman (2021) and Kumar et al. (2021) that pandemic impacts on nations' economic sectors are different and depend on sector intensity to absorb shocks. As such, the impact on the agriculture sector is minimal, however, the impact on the industrial and service sectors is significantly greater owing to the suspension of economic activities, the imposition of lockdown, the closure of businesses, hotels, and other small and medium companies.

Table 4. Regression results.

Dependent variable: Sectoral GNP (2020M2-2022M4)						
Variables	Models with TCC			Model with CAC		
	-1	-2	-3	-4	-5	-6
	LAGNP	LIGNP	LSGNP	LAGNP	LIGNP	LSGNP
LCOVID	-0.00004*** (0.000007)	-0.00005*** (0.00000)	-0.00006*** (0.00001)	-0.00002*** (0.000007)	-0.00003*** (0.000009)	-0.00004*** (0.00001)
LTR	-0.00044*** (0.00006)	-0.0005*** (0.00007)	-0.00064*** (0.00009)	-0.00056*** (0.00006)	-0.00069*** (0.00008)	-0.0008*** (0.0001)
LEC	0.113*** (0.0009)	0.145*** (0.001)	0.179*** (0.00137)	0.110*** (0.0008)	0.142*** (0.0010)	0.176*** (0.001)
Constant	12.88*** (0.0153)	12.34*** (0.0191)	12.94*** (0.0226)	12.92*** (0.0142)	12.39*** (0.0177)	13.00*** (0.020)
R ²	1.000	1.000	1.000	1.000	1.000	1.000
Post estimation tests						
BPG LM	3.7915 (0.150)	3.8022 (0.149)	3.8101 (0.148)	10.388 (0.065)	10.388 (0.065)	10.392 (0.064)
BPG het	4.5352 (0.103)	4.5309 (0.103)	4.5083 (0.105)	3.9584 (0.138)	3.9623 (0.137)	3.9474 (0.138)
Link test	0.0707 (0.762)	0.0885 (0.627)	0.0628 (0.653)	0.2013 (0.513)	0.1327 (0.577)	0.1113 (0.548)
DW stats	1.6507	1.6505	1.6518	1.6843	1.6841	1.6874

Note: ***, indicates significance level at 1 %. AGNP=Agriculture sector gross national product, IGNP=Industrial sector gross national product SGNP=Service sector gross national product, TCC= Total coronavirus cases, CAC= Coronavirus active cases, TR=Trade, and EC=Energy consumption.

The government of Pakistan's smart and complete lockdown, as well as the rising number of virus cases, have harmed the country's service and industrial sector the most, and agriculture the least. Because urban areas are viral

hotspots, they have taken the brunt of the damage, as have the industrial (mostly located in urban areas) and service sectors. Furthermore, international trade restrictions have contributed significantly to the unfavorable growth of the industrial and service sectors as export and import declined by 55 and 35 % in April 2020. Concerning the agriculture sector, even though the food supply network has been disrupted by the pandemic, basic necessities are still available. The virus spread slowly to rural regions, affecting just a small portion of the agricultural sector in the early days (Chen, Brahma, Mackay, Cao, & Aliakbarian, 2020).

The impact of trade on economic growth is generally positive in most cases. However, according to our findings during the COVID-19 period, the impact of trade on sectoral GNP remains negative and highly significant across all specifications. Such that the agriculture sector GNP is reduced by 0.0004 % and 0.0005 % with a 1 % rise in trade in the presence of total and active coronavirus cases. The industrial sector GNP lessened by 0.0005 % and 0.0006 % with a 1 % rise in trade in the presence of total and active coronavirus cases. While service sector GNP is affected greatly as it shrank by 0.0006 % and 0.0008 % with a 1 % rise in trade in the presence of total and active coronavirus cases. Particularly, international trade was curtailed in the early days of the virus (up to 40 % of global trade) because Pakistan's five key trading partners (China, the United States, the United Kingdom, Japan, and Germany) are also the hardest impacted countries by the COVID-19 (GoP, 2020).

However, when trade was opened again after the restrictions all the sectors were already experiencing major losses in their output, income, production, and profitability (UNIDO, 2021). The development of operating cash flow was halted, putting a strain on working capital. In this situation, the firm's credit capacity was indeed restricted, therefore they either used existing savings or shifted the financing trade to credit institutions. The pandemic has also had a significant impact on financial institutions' credit capability (i.e., liquidity and operating cash flows remain constrained, and debt servicing capability slows), needing additional time to fund trade (IFC, 2020). Increased trade harms sectoral GDP as a result. Overall, trade has the most influence on the service sector, followed by the industrial and agricultural sectors, owing to the greater COVID-19 impact on the service sector, followed by the industrial and agricultural sectors.

The impact of energy consumption on sectoral GNP remains positive and highly significant across all models such that a 1 % rise in LEC led to the 0.113 %, 0.145 %, 0.179 % (in terms of TCC), 0.110 %, 0.142 %, and 0.176 % (in terms of CAC) rise in agriculture, industrial and service sector GNP, respectively. Here, the impact of energy consumption is higher for the service sector followed by the industrial and agriculture sector. Energy consumption is critical to the development and economic success of the country. COVID-19 resulted in a reduction in energy consumption due to the shutdown of several industries, the relocation of supply chains, a decrease in air traffic, purchases of various commodities, an increase in mass unemployment, and a dramatic reduction in GDP (Aslam & Sheikh, 2020). However, with the lifting of the lockdown and the reopening of transport, commerce, hotels, and other sectors, economic activity begins to resume and energy consumption rises, increasing sectoral GNP.

Furthermore, the model's constant is positive and significant, meaning that all factors that are not included in the model have a positive influence. The R square value is 1.000, suggesting that 100 % variation is explained by the independent variables included in the model. The values are somehow unexpected from an econometrician point of view and this may be due to the reason of sample size. Breusch-Pagan-Godfrey Lagrange Multiplier (BPG LM) shows no problem of autocorrelation in the errors in the estimated regression model by accepting the null hypothesis of "no autocorrelation." Likewise, the problem of heteroscedasticity is not present in the data since the probability values of the BPG heteroscedasticity test are insignificant accepting the null hypothesis of "no heteroscedasticity." The value of the Link test (hat squared) is insignificant confirming the correct functional form of the model. Lastly, the values

of the Durbin-Watson d-statistic looked to be bigger than R squared suggesting the variables are stationary and thus the estimated regression is not spurious and appropriate for the policy analysis.

5. CONCLUSION

COVID-19 is recognized as one of the most tempting challenges and one of the greatest tragedies of the modern period in the aftermath of World War II. The impacted nations are working to limit the virus's spread through self-distancing, lockdown procedures intensified testing and treatment, and bans on large gatherings. As a result, the whole world population is confronted with major difficulties such as social, environmental, health, and economic concerns. The current study seeks to ascertain the influence of COVID-19 on Pakistan's three primary economic sectors: agriculture, industry, and services. The GNP of the relevant sector is used to measure sectoral development, while COVID-19 is proxied by total coronavirus cases and active cases of the virus reported by Worldometer.

The study covers the period from 2020M2 to 2022M4 and employed the OLS regression method for empirical analysis. The data's stationary property is first tested using the ADF and PP tests, which demonstrate that the variables included in the analysis are stationary at a level. The findings of the OLS show that both the indicators of COVID 19 total and active coronavirus cases are adversely and significantly related to the sectoral GNP. Where the impact of both total and active coronavirus cases on the service sector is higher followed by the industrial and agriculture sector. Further, the impact of trade is also negative and significant across all specifications. In contrast, energy consumption is positively connected to the GNP of each sector.

The study's findings have certain policy implications. With the current economic crisis, the frail health-care system, and crucial health literacy, all sectors of society particularly primary, secondary and tertiary, headed by governmental authorities, demand a well-managed and coordinated action plan. With the halting of economic activity and the negative impact of COVID-19, each sector's weaknesses, strengths, and prospects for recovery and future growth may be clearly seen. Digitization, for example, is crucial for improving sectoral GNP while lowering virus harm. All economic agents can be connected via digital platforms, and sectoral connections may be enhanced without any delays in their services.

The digital network may also monitor pricing stability and product delivery across the supply chain which helps the business keep inflation under control and sell out its products on time. The establishment of connection centers or an online web portal may also aid in connecting the economic centers following the COVID-19 period to maintain maximum business operations and as a result the sectoral GNP. In the absence of extensive economic activities, sustainability measures can easily be identified, taken, and promoted to guarantee sustainable development. With international trade limitations, a list of unneeded imported items may be quickly recognized and banned for reducing the additional strain on economic sectors. Local products may be pushed in the absence of imported commodities, and quality local products can readily replace them. The producers of these items need to be assisted to strengthen local enterprises.

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