

The Impact of COVID-19 on China's Quarterly Economy Growth Rate: Evidence from ARIMA Model

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Abstract: The COVID-19 pandemic unleashed unprecedented economic turmoil worldwide, with China, as its epicenter, experiencing profound repercussions. This study investigates the pandemic's impact on China's Gross Domestic Product (GDP) growth rate, considering macroeconomic, microeconomic, and societal dimensions. COVID-19 disrupted international trade, manufacturing, and supply chains, causing significant economic contractions. China's resilient response strategies, encompassing fiscal policies, digital transformation, and e-commerce promotion, played a pivotal role in stabilizing the economy. Utilizing ARIMA modeling and credible data from the National Bureau of Statistics of China, this research quantitatively assesses the pandemic's effects. It highlights the necessity for adaptable economic models that incorporate dynamic societal changes during crises. Policymakers can draw valuable insights from this study for crafting effective crisis response strategies, while investors can identify sector-specific opportunities in technology and related industries, influenced by shifts in consumer behavior. In summary, this study offers a comprehensive analysis of COVID-19's impact on the growth rate of China's GDP, providing a methodological framework, policy implications, and investment insights. As global economies recover from the pandemic's aftermath, these findings will continue to guide decision-makers in building resilient and adaptable economies for the future.

Keywords: growth rate, GDP, COVID-19

1. Introduction

The emergence of the COVID-19 coronavirus in late 2019 set off an unparalleled worldwide health emergency, rapidly evolving into a complex economic upheaval that impacted nearly every nation across the globe [1]. Among these nations, China, as the epicenter of the pandemic, experienced significant economic repercussions. This research delves into the profound impact of COVID-19 on China's Gross Domestic Product (GDP) growth rate, analyzing the macroeconomic and microeconomic implications, considering the broader global and societal context, and narrowing down to the specific effects within the research field.

The COVID-19 pandemic had extensive effects on China's overall economy because of its significant involvement in global trade, manufacturing, and worldwide supply networks. The virus prompted widespread lockdowns and travel limitations, resulting in disruptions in manufacturing, logistics, and consumption habits, which subsequently impacted the growth of China's Gross

Domestic Product (GDP) [2]. During the initial phases of the pandemic, China experienced a significant reduction in its economic operations due to these disturbances.

The pandemic's socioeconomic impact in China was equally profound. The lockdowns and containment measures necessitated to curb the spread of the virus led to job losses, income disparities, and reduced consumer spending. With millions of businesses forced to shut down temporarily or permanently, the pandemic posed considerable challenges to both employers and employees, further exacerbating the economic downturn [3].

China's position as the world's manufacturing hub made it particularly susceptible to supply chain disruptions. Factory closures, labor shortages, and transport restrictions impacted global supply chains, disrupting the flow of goods and services across borders [4]. The ripple effects of these disruptions propagated throughout the global economy, further impacting China's export-oriented industries and GDP growth.

Within the research field, the pandemic compelled economists, policymakers, and analysts to reevaluate existing economic models and growth projections. Traditional forecasting models, which had not accounted for the unprecedented scale and speed of the COVID-19 pandemic, were rendered less reliable. Researchers were compelled to incorporate newer factors like the infection rate, healthcare capacity, and the effectiveness of government policies to understand the dynamics of China's GDP growth during the pandemic [5].

China adopted a range of strategies to alleviate the economic consequences of COVID-19. The authorities employed a mix of monetary and fiscal approaches to stabilize the economy, emphasizing higher government expenditure, specialized credit assistance, and improved social welfare benefits. Additionally, the promotion of digital transformation and e-commerce helped sustain economic activity during the lockdowns [6].

The pandemic significantly altered consumer behavior, driving a surge in online shopping and digital services. E-commerce platforms, digital payment systems, and online entertainment witnessed a sharp increase in demand as consumers adapted to social distancing measures. These shifts in consumer preferences and spending habits had implications for specific sectors of the economy, influencing the overall GDP growth rate [7].

Although China successfully contained the initial surge of the pandemic, economists and researchers are still intrigued by the enduring effects on its GDP growth. The pandemic highlighted the need for resilience in the face of unforeseen challenges and the necessity to diversify supply chains to reduce future vulnerabilities [8].

The COVID-19 pandemic had a significant influence on China's GDP growth rate, causing extensive repercussions in macroeconomic, socioeconomic, and microeconomic dimensions. The disruption of global supply chains shifts in consumer behavior, and China's response and recovery measures played a pivotal role in shaping the economic trajectory during the pandemic. As the world emerges from this crisis, policymakers and researchers must continue to analyze and learn from the events of this historic period to build a more resilient and adaptable economy for the future. Subsequently, models to analyze certain data will be shown and individuals are able to comprehend and conclude what happened previously.

2. Research Design

2.1. Data Source

The information is extracted from the National Bureau of Statistics of China's (NBS) official website. It stands as a cornerstone resource for a myriad of stakeholders, including researchers, economists, policymakers, and analysts, all of whom seek to unravel the nuanced intricacies surrounding China's economic landscape, with a particular focus on comprehending the growth rate of its Gross Domestic

Product (GDP) [9]. As the authoritative government agency responsible for meticulously collecting and disseminating data, the NBS provides a trove of meticulously vetted and reliable information, ensuring the highest levels of precision and credibility [9]. The NBS data repository not only serves as an essential tool for domestic insights but also acts as a valuable resource for international economic research, allowing economists and international organizations to benchmark China's GDP growth rate against global trends and undertake cross-country comparisons [9]. The NBS data repository not only serves as an essential tool for domestic insights but also acts as a valuable resource for international economic research, allowing economists and international organizations to benchmark China's GDP growth rate against global trends and undertake cross-country comparisons [9]. Therefore, the data from this website is convincing. Researchers can make the use of the data there and do research based on it.

2.2. Weak Stationarity Test

This article uses the data modeling by the time of the pandemic to construct “How would the economic growth rate change if the epidemic did not occur” through modeling. The initial stage involves assessing the stationarity of the data prior to moving forward. After performing the assessment using Stata, the p-values in Table 1 corresponding to Ln GDP, Ln GDP growth rate (YOY), and the first-order difference of Ln GDP growth rate (YOY) are notably low, indicating statistical significance. These findings strongly suggest that the variable does not display a unit root. In simpler words, the model built from the data is reliable and indicates that the data show stationarity.

Table 1: Weak stationarity test.

	t-statistic	p-value
Ln GDP	-4.374	0.0024
Ln GDP growth rate (YOY)	-2.77	0.2080
1st order difference of Ln GDP growth rate (YOY)	-5.561	0

2.3. ARIMA

ARIMA (Autoregressive Integrated Moving Average) is a commonly employed forecasting model for time series data, which blends autoregressive (AR) and moving average (MA) elements while also incorporating differencing to capture and forecast patterns in time-dependent data. ARIMA models are employed in various fields, including economics, finance, epidemiology, and climate science, to forecast future values based on historical observations [10]. The ARIMA model is represented as ARIMA (p, d, q). In this notation, "p" signifies the count of Autoregressive terms (lags) incorporated into the model. "d" denotes the number of differences needed to make the data stationary (integration order). Lastly, "q" represents the quantity of Moving Average terms (lags of forecast errors) integrated into the model [11].

3. Empirical Results and Analysis

3.1. Order

When it comes to figuring out the order of logarithmic stock return, the Partial Autocorrelation Function (PACF) and Autocorrelation Function (ACF) can assist in pinpointing the lag orders for the Autoregressive (AR) and Moving Average (MA) elements. In Figure 1, it can be observed that the initial portion exceeding the critical values is 1 in both the PACF and ACF plots. This indicates that the orders for AR(p) and MA(q) are both 1, with the values of p and q being equal to 1.

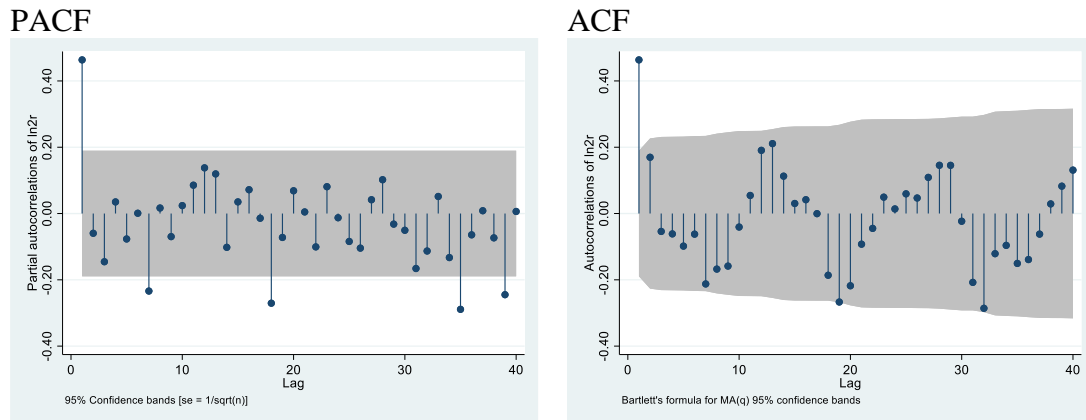


Figure 1: ARMA (p, q) identification.
 Photo credit: Original

3.2. Residual Test

The provided data in "Table 2 Residual Test" appears to present the results of a statistical test performed on the residuals of an ARIMA (7,1,1) model. Residuals represent the disparities between the real observed values and the values foreseen by the model. This test is conducted to assess whether the residuals exhibit any significant autocorrelation, which could indicate that the model has not adequately captured certain patterns in the data. The column indicates the specific ARIMA model that was tested, which is ARIMA (7,1,1). The figures enclosed in the parentheses indicate the sequence of the autoregressive (AR), differencing (I), and moving average (MA) components within the model. The Portmanteau statistic, often denoted as "Q" statistic, is a test statistic used to evaluate the overall autocorrelation in the residuals. It quantifies the sum of squared autocorrelations at different lags. In this case, the calculated Q statistic for the ARIMA (7,1,1) model is 52.1360. Additionally, the associated probability, indicated as "Prob > chi2," was found to be 0.0947. This probability reflects the likelihood of observing the calculated Q statistic under the assumption of no autocorrelation in the residuals.

Table 2: Residual test.

Model	Portmanteau (Q) statistic	Prob > chi2
ARIMA (7,1,1)	52.1360	0.0947

3.3. Predicted Results and Explanations

The provided data, comparing the actual growth rate of China's GDP with a fitted growth rate that excludes the influence of COVID-19, offers valuable insights into the extent of this impact. In early 2020, the outbreak of COVID-19 led to unprecedented lockdowns, travel restrictions, and supply chain disruptions. The Chinese economy, often referred to as the "world's factory," was hit hard as manufacturing and exports contracted. The negative growth rate of -5.65% in 2020 Q1, as shown in the data, marked the first time China's economy shrank since the reforms of the late 20th century.



Figure 2: Actual value and fitted value.

Photo credit: Original

The subsequent quarters of 2020, as depicted in the data, reflect a gradual recovery. However, the gap between the actual growth rate and the fitted growth rate remains indicative of the pandemic's lingering effects. The data suggests that without the pandemic, China's growth trajectory would likely have followed a more stable and positive path. Interestingly, the recovery in 2020 Q2, with an actual growth rate of 2.79%, underscores China's swift response in containing the virus and resuming economic activities. Nonetheless, the difference of -3.67% from the fitted growth rate hints at the challenges that persisted despite the recovery efforts. The impact of COVID-19 extended beyond manufacturing and trade. The service sector, a key driver of China's economy, faced unprecedented challenges due to reduced consumer spending and limited mobility. The data underscores this impact, as growth rates across the quarters remain below the fitted values, indicating the enduring effect of the pandemic on services. The contrasting growth rates in 2021 further illuminate the influence of COVID-19. The first quarter of 2021 saw a sharp rise in the actual growth rate, reaching 19.41%. This surge can be attributed to a low base effect from the previous year's contraction and a gradual global economic recovery. However, the difference of 13.22% from the fitted growth rate emphasizes the extraordinary circumstances that contributed to this rapid growth. By the second and third quarters of 2021, the actual growth rates remained higher than the fitted values, albeit with narrowing differences. This suggests that while China managed to regain economic momentum, the effects of the pandemic continued to create deviations from the expected growth path.

Table 3: Actual value, fitted value and difference.

	Growth rate-Actual value	Growth rate-Fitted value	Difference
2018 Q2	10.35%		
2018 Q3	9.70%		
2018 Q4	9.47%		
2019 Q1	7.22%		
2019 Q2	7.54%		
2019 Q3	6.83%		

Table 3: (continued).

2019 Q4	6.72%		
2020 Q1	-5.65%	6.38%	-12.03%
2020 Q2	2.79%	6.46%	-3.67%
2020 Q3	5.17%	6.10%	-0.93%
2020 Q4	6.58%	6.44%	0.14%
2021 Q1	19.41%	6.19%	13.22%
2021 Q2	13.01%	6.18%	6.83%
2021 Q3	9.70%	5.90%	3.80%

The influence of COVID-19 on China's GDP growth, as highlighted by the data, extends beyond the numbers. It underscores the resilience of China's economy in the face of adversity and the effectiveness of its containment measures. However, it also highlights the lingering challenges and uncertainties posed by the pandemic, particularly in the services sector and in sustaining consistent growth rates.

In conclusion, the data comparing actual and fitted growth rates of China's GDP provides a compelling narrative of the influence of COVID-19. The pandemic disrupted China's economic trajectory, resulting in unprecedented contractions and subsequent recoveries. The differences between actual and fitted growth rates illuminate the ongoing impact of the pandemic, underscoring the complexities and nuances of navigating a global crisis. As the world continues to grapple with the aftermath of COVID-19, the knowledge gained from China's experience will enhance our comprehension of the enduring impacts of the pandemic on economies and societies.

4. Discussion

The results presented in this paper align with earlier studies on how COVID-19 affected China's GDP growth rate. Like existing studies, it acknowledges the significant disruptions caused by the pandemic, particularly in international trade, manufacturing, and supply chains [12]. The paper extends the analysis by employing an ARIMA model to quantitatively assess the pandemic's effect on GDP growth rate, contributing a unique methodological approach to the existing literature. While prior research highlights the macroeconomic consequences, this study further explores microeconomic implications, such as shifts in consumer behavior and the service sector's challenges [12]. These detailed examinations offer a broader comprehension of the diverse repercussions of COVID-19 on China's economy.

The implications of this research are multifaceted. By utilizing reliable data from the National Bureau of Statistics of China, this paper underscores the significance of credible data sources for robust economic analyses. The application of ARIMA modeling offers a valuable tool for economists and researchers to quantitatively assess the effects of unforeseen events on economic indicators. Additionally, the paper's focus on microeconomic aspects and shifts in consumer behavior highlights the need for adaptable economic models that account for changing societal dynamics during crises.

Policy makers can derive actionable insights from this study to shape effective crisis response strategies. The comprehensive analysis of the pandemic's impact on China's GDP underscores the importance of both macroeconomic and microeconomic considerations in formulating policies. The study showcases China's efforts in deploying a combination of monetary, fiscal, and digital transformation measures to stabilize the economy [13]. Policy makers can draw inspiration from these strategies when designing interventions to mitigate the adverse effects of future crises, ensuring resilience across various sectors of the economy.

Investors can leverage the research outcomes to make informed decisions in a rapidly changing economic landscape. The data-driven assessment of COVID-19's influence on GDP growth rate provides investors with insights into sector-specific vulnerabilities and opportunities. The study's emphasis on shifts in consumer behavior towards electronic commerce and digital services highlights potential investment prospects in technology and related industries [14]. Furthermore, the study's findings underscore the importance of monitoring long-term economic trajectories, aiding investors in adjusting their strategies to capitalize on evolving trends and uncertainties.

5. Conclusion

In conclusion, this paper presents a comprehensive analysis of the impact of COVID-19 on China's GDP growth rate, expanding on existing literature by incorporating quantitative modeling and exploring microeconomic dimensions. The research contributes methodologically by utilizing credible data sources and ARIMA modeling, offering a framework for assessing economic disruptions. The growth rate of GDP in China endures a shockwave. It declines and then bounces above its initial level. Then, it returns to its original trajectory. The implications for research, policy making, and investment decisions are significant, providing insights into crisis response strategies, adaptable economic models, and sector-specific opportunities. As economies worldwide work towards recuperating from the aftermath of the pandemic, the knowledge derived from this research will remain valuable for making well-informed decisions, promoting resilience, and adapting to the swiftly evolving global landscape.

Although the paper explores the economic effects, it does not extensively investigate the possible psychological well-being and societal outcomes of the pandemic. These can have indirect but significant effects on the economy, as they can influence workforce productivity, consumer behavior, and government policies. Additionally, the study doesn't extensively address environmental impacts, such as changes in pollution levels and resource consumption during lockdowns, which are increasingly important topics in the context of sustainable economic development. Future research should investigate the enduring impacts of COVID-19 on China's economy, including potential structural changes, shifts in global supply chains, and the evolution of consumer behavior.

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