

Trade performance of Bangladesh during COVID-19 pandemic: An empirical study using CGE model



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ABSTRACT

Article History

Received: 11 December 2025

Revised: 4 February 2026

Accepted: 13 March 2026

Published: 17 April 2026

Keywords

Bangladesh

CGE model

COVID-19

Demand shock

Trade disruptions

Trade performance.

The purpose of the study is to analyze the trade performance of Bangladesh during the COVID-19 pandemic. The study identifies the effects of private consumption demand shocks and trade disruptions caused by higher trade costs due to the pandemic on Bangladesh's export and import in different sectors. It also compares the analysis results with actual data. Based on previous literature, this study assumes low, medium, and high shocks and examines their effects on trade in Bangladesh. The study applies the CGE model using GTAP to measure the effects of these shocks on trade and output, comparing actual trade data with CGE-simulated results. The findings suggest that both demand shocks and trade disruptions significantly impact Bangladesh's export, import, and domestic output during the pandemic. It is also evident that higher levels of shocks lead to greater impacts on trade and output. The CGE model further analyzes the combined effects of both shocks on Bangladesh's trade performance. Results indicate that the combined effects are higher than their individual effects across all sectors. The actual export and import data cross-validate the CGE analysis results, providing mixed findings regarding the trade performance of various sectors during the pandemic.

Contribution/ Originality: The study's findings offer vital policy insights. The findings show that the COVID-19 pandemic's demand and trade shocks have a significant impact on Bangladesh's exports and imports. Given that Bangladesh's economy is heavily dependent on exports and imports, appropriate measures should be taken to offset the effects of shocks on Bangladesh's trade and output.

1. INTRODUCTION

The COVID-19 pandemic was projected to considerably impact worldwide trade due to its complex implications on supply chains and other economic and financial problems. The global economy suffered significantly due to the lockdown to control the spread of the virus. The infection epidemic substantially impacted global economic development. The virus was anticipated to decrease global economic growth by more than 2.0% per month if the current trend continues (Verma et al., 2021). The economic destruction caused by the pandemic impacted the global economy by obstructing trade and production (Baldwin & Tomiura, 2020).

The pandemic significantly damaged global supply chains. Significant setbacks were experienced in the performance of finances, lead times, customers, and manufacturing. It caused a problem that impacted supply and demand, making the pandemic more challenging to respond to effectively. The initial shock was on the supply side. Then, as containment measures were implemented, demand significantly increased (Fonseca & Azevedo, 2020). Unlike prior epidemics, this pandemic simultaneously affected every node (supply chain member) and edge in a supply chain (Gunessee & Subramanian, 2020). The flow of the supply chain was considerably disrupted as a result. Supply, transportation, and production capacity were constrained by factors such as border closures, supply market

restrictions, obstructions to vehicle and commerce movements, lack of labor, and the maintenance of physical separation in manufacturing facilities (Amankwah-Amoah, 2020; Paul, Chowdhury, Moktadir, & Lau, 2021). Thus, the pandemic greatly impacted global trade due to the disruption of the worldwide supply chain.

Due to the lockdown and shutdown scenarios, Bangladesh faced several unanticipated issues affecting its citizens' economy, trade, education, industry, politics, and daily life. The country's GDP was predicted to be lower than in previous years, and the poverty rate increased dramatically. Over the past ten years, Bangladesh's GDP grew remarkably, with an annual growth rate of 7.9% before the pandemic. Due to economic downturns caused by COVID-19 lockdowns, Bangladesh's GDP drastically fell (IMF, 2020). The socio-economic growth of Bangladesh slowed during and after the pandemic. As a result of increased pandemic-related spending on health, education, infrastructure, and social protection, combined with the nation's deteriorating economic situation, Bangladesh's external debt-to-GDP ratio increased from 36 percent to approximately 41 percent. Because most businesses stopped hiring to cut operating costs, the pandemic reduced work opportunities and increased Bangladesh's graduate unemployment rate (Shahriar, Islam, Zayed, Hasan, & Raisa, 2021).

As the COVID-19 outbreak forced countries to close borders, it threatened more than just one country's health and had a negative social, political, psychological, and economic impact on the entire world. This outbreak also disrupted educational institutions, tourism, investment, exports, and imports (Hassani & Shahwali, 2020). The pandemic had a significant economic impact on all sectors and firms of different sizes, to varying degrees of capacity utilization, and under various scenarios of total, protracted, and partial lockdown. Ready-made garments (RMG), the largest exporting sector in Bangladesh, experienced negative growth (-5.5%) in the first eight months of the pandemic. All important export items, except jute and jute products, saw negative growth, and real export earnings decreased (BBS, 2021).

On the other hand, import payments grew at a negative rate of -2.2%, and the performance of the import sector pointed to an economy that experienced a fall in demand, which hurt economic growth. In terms of import payments, import sub-components such as capital goods (-8.3%), including capital machinery (-22.0%), and intermediate inputs (-2.1%) had negative growth in the (Rahman, Razzaque, Rahman, & Shadat, 2020). With a combined employment rate of 60% and a 32% contribution to Bangladesh's GDP, agriculture and industry dominated the local trade in Bangladesh (BBS, 2021).

It is evident that the COVID-19 pandemic negatively impacted Bangladesh's trade in two ways. First, it created a demand shock in the national and international markets due to reduced demand resulting from lower income during the pandemic. During this period, local trade in Bangladesh was severely harmed by several concerns, such as employment losses in the sector (especially in ready-made garment factories) and declining consumer demand due to falling industry wages. Moreover, Ready-Made-Garments (RMG) is Bangladesh's principal source of foreign exchange earnings and constitutes 85% of total export earnings. The USA and the EU are the main export markets for Bangladesh, comprising almost two-thirds of RMG exports. The COVID-19 pandemic has drastically impacted the USA, the EU, and other developed economies, substantially reducing demand for goods and services in the global market due to lower income caused by job loss during the pandemic (Raihan, 2020).

Second, the pandemic impacted trade through supply shocks caused by trade disruptions arising from higher trade costs and disruptions of global supply chains. The lockdown policy to control the spread of the virus significantly disrupted global communication and supply chains, making international trade costly and complex. Bangladesh is an export-oriented country, and a large share of its export industries, especially the RMG sector, are import-based. Thus, trade disruptions critically affected Bangladesh's exports and imports. However, the crucial research question is whether Bangladesh performed well in international trade during COVID-19 despite the various shocks posed by the pandemic.

This study aims to analyze Bangladesh's trade performance during the COVID-19 pandemic and contributes to existing research in several ways. First, it identifies Bangladesh's trade scenarios during the pandemic with

descriptive data. It then applies a computable general equilibrium (CGE) model using the GTAP database to simulate trade scenarios in different sectors under various shock levels caused by the pandemic. Finally, the study examines the effects of different demand shock levels and trade disruptions due to increased trade costs from COVID-19 on exports and imports, comparing these with actual data. It also offers policy suggestions regarding Bangladesh's trade performance during the pandemic.

This study stands out and makes a significant contribution to the body of knowledge. Studies have little interest in comparing actual and predicted data to assess a country's trade and economic performance, despite documents and studies claiming that COVID-19 had a significant impact on a country's trade and economy. Additionally, assessing how various industries fared during the pandemic is essential to developing the right policies with a wider and more comprehensive perspective. These significant research and policy issues are the focus of this study. Using a simulation approach through the CGE model and the GTAP database, it projected the impact of COVID-19 on trade while accounting for various shocks at different levels. It then compares the simulated and real data of various sectors and offers a comprehensive message on the trade performance of various sectors, which subsequently aids in formulating appropriate sector-specific policy.

The remainder of the study is arranged as follows. The next section discusses the relevant literature and identifies the research gap. Section three describes the methodology, software packages, and data used in the study. Section four discusses the analysis results. The last section makes conclusions and provides policy directions.

2. LITERATURE REVIEW

Theoretically, COVID-19 is likely to have a significant impact on global trade in various ways. The economic impact of the outbreak has been referred to as "Corononomics" by Eichengreen (2020) and the "Black Swan" by Petro (2020). Due to the lockdown to contain the virus's spread, the outbreak has de-globalized the world by obstructing the flow of goods, capital, production, and business. Before COVID-19, several epidemics and pandemics throughout history, including SARS-1 in 2003, the Spanish flu of 1928, mild and severe flu in the US and UK, the African Ebola virus, HIV, and more, had a significant negative impact on the world economy. In various literature, such as Galiani (2022), Garrett (2008), and Van Bergeijk (2021), the economic effects of pandemics are commonly called "Pandemic economics." Numerous studies on the economic consequences of pandemics concluded that pandemics significantly negatively impact economic growth, unemployment, industrial production, consumption, and cross-border movement of people and goods. Studies James and Sargent (2006), Kennedy, Thomson, and Vujanovic (2006); Keogh-Brown, Wren-Lewis, Edmunds, Beutels, and Smith (2010), Lee and Cho (2016), Lee and McKibbin (2012), and Wong (2008) showed that a prolonged recovery period is necessary to counteract the pandemic's adverse effects. However, it is widely acknowledged that the COVID-19 pandemic's economic impact is broader and more severe than previous pandemics because of the virus's characteristics and rate of spread.

An exporting nation's increased COVID-19 load inevitably shrank the size of the industry, which lowers export supply. Exports declined, particularly in fields and countries where working remotely was impractical. A commodity's domestic demand as well as production were affected by the COVID-19 load. Redirecting the amount not consumed at home to the export market resulted in a net rise in exports if the decline in domestic demand outweighed the decrease in output. In an economy that imports goods, the burden of COVID-19 was mostly felt due to a reduction in aggregate demand. As a result of decreased incomes and fewer retail store visits, demand will decline. The short-term impact of COVID-19 on global poverty was calculated by Sumner, Hoy, and Ortiz-Juarez (2020). Each scenario's effect on the number of people living in poverty is computed using the global poverty standards of US\$1.90, US\$3.20, and US\$5.50 per day. Because poverty levels increased after the epidemic in 1990, the outcome conflicts with the UN Sustainable Development Goal (UNSDG), which states that poverty would be almost entirely eradicated by 2030.

A study predicted that real GDP growth would be 3% globally and 6% in the US, making 2020 the worst recession since the Great Depression. Both agricultural trade and general international trade will be significantly

impacted (IMF, 2020). The WTO has forecast a range of 13% to 32% for the potential loss in overall trade volume, but because of falling prices, it is likely to be significantly worse in value terms. A study by Hassani and Shahwali (2020) conducted a thorough analysis of 42 countries using the computable general equilibrium (CGE) model and found that the pandemic will result in a \$905 billion decline in world trade. The scenario of prolonged containment will result in a \$2,095 billion reduction in world trade.

According to Hayakawa and Mukunoki (2021), the COVID-19 burden has a significant negative impact on trade in exporting countries but not in importing ones. Exports from developing countries are negatively impacted by exporters' COVID-19 burden, but not those from wealthy nations. They further argued that an exporter benefits from the burden of COVID-19 in its neighboring countries. Importers' COVID-19 load benefits trade in the agricultural sector, but exporters' COVID-19 burden hurts it, particularly in the textile, footwear, and plastics sectors. Dhinakaran and Kesavan (2020) discussed the stagnation of India's exports and imports during COVID-19. The authors concluded that during the COVID-19 shutdown, India's exports and imports declined. Following the COVID-19 shutdown, India's national and state governments must deal with several social, economic, political, and institutional issues.

Maliszewska, Mattoo, and Van Der Mensbrugge (2020) assessed the likely effect of COVID-19 on GDP and trade using a standard global computable general equilibrium model. The study suggested that the pandemic caused a 2% decline in GDP worldwide, a 2.5% decline in least developed countries, and a 1.8% decline in industrialized ones. In an improved pandemic scenario where containment is anticipated to take longer and now seems more likely, the falls are almost 4% lower than the global average. The output of pandemic-affected home services as well as traded tourism services, shows the greatest negative shock. According to Gruszczynski (2020), the COVID-19 pandemic's effects are most palpable in the global services sector. The main losers are international tourism, passenger air travel, and container transportation. Both international financial transactions and the use of information and communication technology services have sharply declined. Thus, the study draws the following hypothesis.

Hypothesis 1: The COVID-19 pandemic significantly impacted the export and import of Bangladesh.

Islam and Fatema (2023) argued that the Covid-19 pandemic affected business and trade through two different channels: supply shock due to disruptions of global supply chains and demand shock caused by lower income resulting from job losses. The pandemic is projected to have a significant impact on worldwide trade because of its complex implications on supply chains and other economic and financial issues (Chowdhury, Paul, Kaisar, & Moktadir, 2021; Donthu & Gustafsson, 2020). A rise in imports from other nations may result from this decline in trade prices. Conversely, negative production shocks caused by COVID-19 in one country may reduce production in other nations through supply-chain networks (Hayakawa & Mukunoki, 2021). The pandemic has significantly impacted the world's supply chain since the only way to effectively stop the virus from spreading is to impose a rigorous lockdown that restricts people's movement (ADB, 2020). Additionally, the pandemic has reduced output as demand has decreased due to lockdowns and other emergency measures. Demand has been impacted by consumers' hesitation to spend money right now worldwide. This phenomenon can be explained by greater uncertainty and a generalized fear of losing money (Due, for instance, to unemployment).

According to Zayed, Khan, Shahi, and Afrin (2021), international trade will suffer during a pandemic because there will be less demand for goods and services globally. The travel, tourism, and building industries would all suffer as a result. The world's reserves of commodities and supply chains may be in danger. Both the governmental and commercial sectors in emerging nations may be able to grow their debt due to the accessibility of low-interest loans. The COVID-19 tragedy will hurt the world economy.

Segal and Gerstel (2020) argued that the growth of COVID-19 interferes with government commitments and the supply chain. The virus worsens economic uncertainty, as the financial crisis of 2008 demonstrated. Due to COVID-19's effects on the Chinese economy, automobile sales in January and February were reduced by a record 80 percent, and exports by 17.2 percent. The global COVID-19 epidemic is predicted to cause a 1.5 percentage point

slowdown in the global economy in 2020. The social distancing motto will pose problems for tourism and travel-related companies. The manufacturing sector will suffer as a result. On the other hand, Liu, Ornelas, and Shi (2022) inferred that a country's imports from China were significantly reduced by its own COVID-19 deaths and lockdowns. They suggested that the pandemic's adverse effects on demand outnumbered those on supply. However, the COVID-19 deaths in a nation's main trading partners (apart from China) led to increased imports from China, somewhat offsetting the nation's effects. They also considered how the pandemic would affect China's exports to the world and its purchases from the world in 2020 and concluded that the path of causation is not linear. Instead, several aspects of the pandemic are likely to have an impact on international trade, including its direct health impact and the behavioral changes that result in the affected countries, the effects of the government's measures to stop the virus's spread, and the effects in third countries as a result of the pandemic's impact there. According to Delardas, Kechagias, Pontikos, and Giannos (2022), the effects of COVID-19 were diverse and frequently spread to different or connected businesses. There were both top-down and bottom-up economic shocks and significant adjustments in corporate and individual circumstances that impacted both domestic and global trends in supply and demand for goods and services. The elementary and secondary sectors were particularly impacted by a lack of supply, whereas the services and educational sectors were dominated by demand. Naseer et al. (2023) assert that the COVID-19 pandemic has impacted several industries, including manufacturing, international trade, consumer spending, and the labor and capital markets. Both domestic and international businesses would experience financial losses as a result of the products' supply chains being disrupted. Based on the above arguments, the study draws the following hypothesis.

Hypothesis 2: The impact of the COVID-19 pandemic on trade significantly and substantially differs across different types of shocks at various degrees.

Chowdhury, Sarkar, Paul, and Muktadir (2022) conducted a case study on managing the COVID-19 pandemic's effects on the food and beverage sector. The study found that while the medium- to long-term implications of this pandemic seem complex and uncertain, the short-term effects, such as product expiration, a shortage of operational capital, and restricted distributor activities, are severe. Numerous performance indicators, including firm return on investment, GDP contribution, and workforce size, are expected to worsen over time. Additionally, companies might need to change their relationships with distributors, trading partners, and supply chains.

Barichello (2020) predicted that trade in agricultural products will be less impacted in Canada because of its relatively low-income elasticity of demand. However, it is reasonable to expect a 12%–20% fall in the actual transaction value. Grain exports will be the least impacted among agricultural exports, but Canada can be expected to participate. Canada will have the best chances in the grains group because it has the lowest income elasticity. Furthermore, the Canadian wheat business will profit if more widespread export restrictions are implemented, such as those for wheat. Livestock, pulses, and horticulture are predicted to have a more extensive trade decline because of the significant loss of purchasing power in many importing nations.

Evenett et al. (2022) conducted a study on trade policy remedies for the COVID-19 pandemic crisis. This article aims to provide a descriptive evaluation of the trade policy responses to the COVID-19 epidemic. The analysis revealed significant heterogeneity at the national level in the application of trade policy and the types of measures taken. A few nations took steps to limit exports and ease imports, while others focused exclusively on one of these margins, and a large number did not utilize trade policy at all. The observed variability raises several research concerns about the factors that led to trade policy responses to COVID-19, how these measures affected trade and the pricing of important goods, and how trade agreements influenced the use of trade policy. According to Abbas et al. (2022), the industries most affected include tourism and travel, financial markets, entertainment, manufacturing, etc., which have a severe impact on the country's gross domestic product. Thus, the study hypothesizes that:

Hypothesis 3: The COVID-19 pandemic has varying impacts on trade in different sectors in Bangladesh.

The above discussion on literature shows that several studies anticipated the potential impact of COVID-19 on global trade as well as trade in different sectors of a specific country or group of countries. It is crucial to identify the

simulated effect of the pandemic on trade and compare the potential effect with the actual performance of a country. Since Bangladesh's economy is highly dependent on trade, it is probable that COVID-19 had a significant effect on its trade. Comparing this with the actual trade performance of the country provides a clearer picture of the real trade scenario during the pandemic.

A descriptive analysis of the macroeconomic effects of COVID-19 in Bangladesh was conducted by Ahamed (2021). They argued that although the economy was not in danger due to the immediate economic shock of COVID-19, long-term shockwaves from global uncertainty could be very harmful. An integrated macroeconomic framework architecture is crucial for the economy since shocks in the informal sectors are difficult to understand. Policymakers need to be aware of the circumstances and take decisive action. Kumar and Nafi (2020) found that Bangladesh experienced an adverse impact on inbound and outbound tourism. The intensification of COVID-19 is predicted to cause a long-term adverse effect on tourism in Bangladesh. Alam, Ali, Bhuiyan, Solaiman, and Rahman (2020) argued that the magnitude of the pandemic's economic losses in Bangladesh will depend on how the outbreak evolves, as any pandemic disease and its economic consequences are vastly ambiguous, making it challenging for policymakers to develop appropriate macroeconomic policy guidelines.

However, none of the studies focused on identifying the potential effect of COVID-19 on Bangladesh's trade performance caused by demand stickiness and trade disruptions due to higher trade costs resulting from the pandemic. This study aims to fill this research gap. It identifies trade scenarios during the pandemic with descriptive data and simulates trade scenarios in different sectors under various levels of shocks caused by COVID-19 using a computable general equilibrium (CGE) model based on the GTAP database. It analyzes the effects of different levels of demand shocks and trade disruptions caused by increased trade costs due to COVID-19 on exports and imports during the pandemic, comparing these with actual data.

3. METHODOLOGY

The analysis of this study was conducted on three different levels: descriptive analysis showing Bangladesh's trade scenario during the pandemic, application of the CGE model using the GTAP database to identify the effects of demand shocks and trade disruptions caused by trade costs on exports and imports during the pandemic, and comparing actual trade performance with CGE simulated results. Based on previous studies such as ADB (2020) and Maliszewska et al. (2020), this study applies the CGE model approach using two different shocks: demand shock resulting from reduced household consumption and trade disruptions caused by higher yardage costs during the pandemic. Moreover, studies such as ADB (2020), Maliszewska et al. (2020), and Rahman et al. (2020) assumed that the COVID-19 pandemic could cause shocks at different levels depending on the severity and duration of the pandemic. The proposed shocks are in three scenarios: low, medium, and high. As previous studies suggest, this study assumes private consumption (as a proxy for demand shock) to decline by 2%, 3.5%, and 5% under low, medium, and high shock scenarios, respectively, and trade costs (as a proxy for trade disruptions) to increase by 1.5%, 2.5%, and 5% in these scenarios.

The study applies computable general equilibrium (CGE) modeling using the Global Trade Analysis Project (GTAP) to quantify the effects of demand shocks and trade disruptions during the Covid-19 pandemic on Bangladesh's exports, imports, and domestic output. A CGE model simulates how an economy might respond to changes in technology, policy, or other variables. It is a numerical representation of the economy. CGE models combine economic theory with actual data to accurately reflect the structure of the economy and the actions of entities such as businesses, people, and governments. A CGE model also accounts for supply constraints, relative pricing, and connections between markets and economic sectors. It is a set of equations that illustrate the economic interactions among individuals, organizations, governments, and the rest of the world. CGE models can be used to guide policy formation and analysis through scenario simulation. This model provides economists and decision-makers with common discussion points and enables them to examine significant, discrete policy changes that deviate from the baseline,

Bangladesh, China, ASEAN, and the rest of the world, as shown in Table 2. The factors of production are divided into four types: land, labor, capital, and natural resources, as described in Table 3. Finally, in the GTAP CGE simulation, this study assumes private consumption (as a proxy for demand shock) and trade costs (as a proxy for trade disruptions) under low, medium, and high shock scenarios. The solution algorithm used is the Johansen method with automatic correctness to ensure high accuracy in the results.

Table 1. Sector aggregation.

Sector	Comprising
Textiles	Textiles
Apparel	RMG products
Leather	Leather
Fish	Fish
Othermnf	All other manufacturing
Service	All services
AgriFood	All agriculture and food products

Note: The sector was grouped and defined based on the HS/ISIC codes following (Aguilar, Chepeliev, Corong, McDougall, & Van Der Mensbrughe, 2019).

Table 2. Region aggregation.

Region	Comprising
Bangladesh	Bangladesh
South Asia	All South Asian countries, excluding Bangladesh
Rest of world	Countries from the rest of the world

Table 3. Factor aggregation.

Factor	Comprising
Land	Land
Capital	Capital
NatRes	Natural resources
Labor	Technicians/Assoc professional; Clerks; Service/Shop workers; Officials and managers; agricultural and unskilled

4. ANALYSIS AND FINDINGS

Figure 2 shows the yearly imports of Bangladesh with major trading countries in billion dollars. It shows that China is the largest importing country of Bangladesh. In 2018 and 2019, the total value of imports, respectively, was US\$1.489 billion and US\$1.702 billion. In 2020, imports were US\$1.3148 billion, and in 2021, US\$2.331 billion. Here, we can see that the value of imports in 2019 is higher than in 2018, but during the COVID-19 period in 2020, the value of imports decreased.

However, in 2021, it increased again. Therefore, the highest increase occurred in 2021. India is the second-largest importing country of Bangladesh. From this figure, we see that during the COVID-19 period in 2020, the value of imports was US\$7.818 billion, which was lower than the previous year. But in 2021, it increased again. Bangladesh also imports from the USA, Japan, and Singapore. Imports from Singapore in 2018 and 2019 were US\$2.960 billion and US\$2.585 billion.

As a result of COVID-19, the value of imports in 2019 decreased. During this period, the total value of imports was US\$2.121 billion, and there were no imports in 2021, fewer imports from the UK, France, Germany, and Italy. Due to COVID-19 during 2020-2021, there were no imports from France.

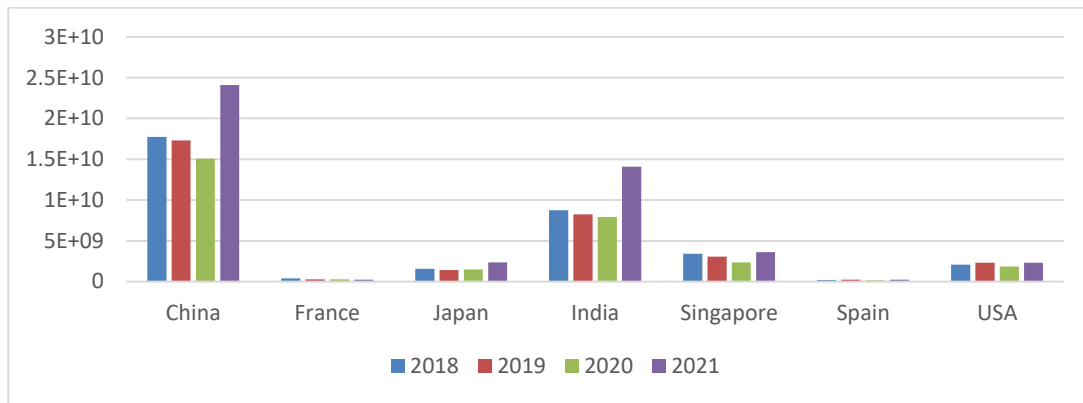


Figure 2. Import sources of Bangladesh.

Source: Data collected from the UNCOMTRADE Database.

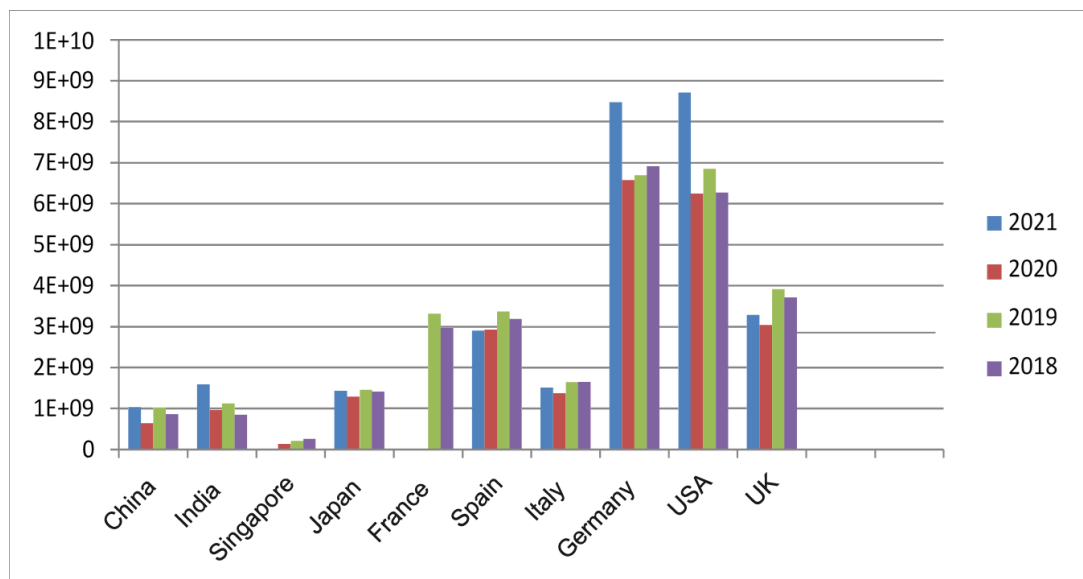


Figure 3. Export destinations of Bangladesh.

Source: Data collected from the UNCOMTRADE Database.

Figure 3 shows that the United States is the largest importer of Bangladeshi products. In 2018 and 2019, the total value of exports was US \$6.266 billion and US \$6.849 billion, respectively, which is higher than the previous year. However, in 2020, exports decreased to US \$6.0531 billion. A positive aspect is that over time, the country's export capacity increased again in 2021, with an increase of US \$2.46 billion. Therefore, 2021 saw the highest increase. Germany is the second-largest exporting country for Bangladesh. During the COVID-19 period in 2020, exports were US \$65.71 billion, lower than the previous year. But in 2021, exports increased again, reaching US \$84.75 billion, higher than in 2020. This indicates that Bangladesh managed to recover from the COVID-19 situation. The UK is another significant export destination for Bangladesh. In 2019, exports to the UK were valued at US \$3.918 billion, higher than in 2018. However, in 2020, during COVID-19, exports declined to US \$3.045 billion, which was lower than in 2019. Although the export volume increased in 2020 compared to 2019, it remained below the levels of 2018 and 2019. France is also an important export partner for Bangladesh, but in 2020, during COVID-19, exports to France were most affected, with no exports recorded in 2020-21.

Bangladesh also imports from the USA, Japan, and Singapore. Imports from Singapore in 2018 and 2019 were US \$2.96 billion and US \$2.58 billion, respectively. Due to COVID-19, the value of imports in 2019 decreased. During this period, the total value of imports was US \$2.12 billion, and there were no imports in 2021, fewer imports from the UK, France, Germany, and Italy. However, because of COVID-19 during 2020-2021, there are no imports from France.

The CGE model analyzes the effect of private consumption demand shock and trade shock caused by higher costs during the pandemic at low, medium, and high levels of shock. The study measures the effects of both shocks separately as well as combined using the GTAP database. Both shocks are assumed to occur at low, medium, and high levels of shocks.

Table 4. Trade effects due to fall in domestic household consumption during COVID-19 (Demand shock) at the low level (1.5%).

Sectors	Value of exports(qxw)			Value of imports (qim)			Domestic output (qo)		
	Pre	Post	Change	Pre	Post	Change	Pre	Post	Change
Textiles	1162	1161	-1	10183	10195	12	10600	10607	7
Apparel	28019	28022	3	459	460	1	28400	28403	3
Leather	1122	1121	-1	492	494	2	2659	2661	2
Fish	79	80	0	70	70	0	10674	10692	18
Other manufacturing	833	829	-4	26599	26623	24	33599	33564	-35
Service	317	316	-1	2570	2573	4	173314	173226	-88
Agri & food	1522	1521	-1	8281	8303	22	75094	75225	131

Source: GTAP database CGE simulation results. Figures in million US\$.

Table 5. Trade effects due to fall in domestic household consumption during COVID-19 (Demand shock) at the medium level (2.5%).

Sectors	Value of exports(qxw)			Value of imports (qim)			Domestic output (qo)		
	Pre	Post	Change	Pre	Post	Change	Pre	Post	Change
Textiles	1162	1159	-3	10183	10211	27	10600	10616	16
Apparel	28019	28025	6	459	462	3	28400	28407	7
Leather	1122	1119	-2	492	496	4	2659	2665	5
Fish	79	80	0	70	71	1	10674	10717	43
Other manufacturing	833	823	-10	26599	26655	55	33599	33517	-82
Service	317	315	-2	2570	2578	9	173314	173108	-206
Agri & food	1522	1519	-2	8281	8332	51	75094	75400	305

Source: GTAP database CGE simulation results. Figures in million US\$.

Table 6. Trade effects due to fall in domestic household consumption during COVID-19 (Demand shock) at the high level (5%).

Sectors	Value of exports (qxw)			Value of imports (qim)			Domestic output (qo)		
	Pre	Post	Change	Pre	Post	Change	Pre	Post	Change
Textiles	1162	1158	-4	10183	10222	39	10600	10623	23
Apparel	28019	28028	9	459	463	4	28400	28410	10
Leather	1122	1118	-3	492	498	6	2659	2667	8
Fish	79	80	0	70	71	1	10674	10735	61
Other manufacturing	833	819	-14	26599	26679	79	33599	33482	-118
Service	317	315	-2	2570	2582	13	173314	173020	-294
Agri & food	1522	1518	-3	8281	8354	74	75094	75530	436

Source: GTAP database CGE simulation results. Figures in million US\$.

Tables 4, 5, and 6 summarize CGE analysis results for demand shocks at three different levels. The analysis indicates that a low-level demand shock (1.5%) reduced exports in all sectors except apparel and fish. The largest reduction is in the other manufacturing sector (\$40.9m), followed by textiles (\$1.17m). Conversely, apparel exports will increase by \$2.59m, with a slight volume rise in the fishing sector.

In the case of imports, the analysis results suggest that despite the negative domestic demand shock caused by the pandemic, the import value of different sectors increased, with the highest increase in other manufacturing sectors (\$23.78m), followed by agriculture and food (\$22.05m), and textiles (\$11.72m). The effects of demand shocks on domestic output are also critical. The demand shock induced by the COVID-19 pandemic reduced domestic output in the service sector (\$88.34m) and other manufacturing sectors (\$35.32m), whereas the output of other sectors increased. The agriculture and food sector experienced the highest increase in output by \$130.82m, followed by the fish and apparel sectors. The CGE model determines the effects of shocks at three different levels on Bangladesh's

trade performance. The analysis results at medium and high-level shocks suggest that greater shocks will have a greater impact on export, import, and domestic output.

Table 7. Trade effects due to trade disruptions during COVID-19 (Trade costs) at a low level (1.5%).

Sectors	Value of exports (qxw)			Value of imports (qim)			Domestic output (qo)		
	Pre	Post	Change	Pre	Post	Change	Pre	Post	Change
Textiles	1162	997	-165	10183	9239	-944	10600	10380	-220
Apparel	28019	25316	-2703	459	431	-28	28400	25702	-2699
Leather	1122	1029	-92	492	447	-45	2659	2599	-60
Fish	79	77	-3	70	68	-2	10674	10670	-4
Other manufacturing	833	781	-52	26599	25274	-1326	33599	35443	1844
Service	317	295	-21	2570	2450	-120	173314	174044	730
Agri & food	1522	1407	-114	8281	7853	-428	75094	75433	339

Source: GTAP database CGE simulation results. Figures in million US\$.

Table 8. Trade effects due to trade disruptions during COVID-19 (Trade costs) at the medium level (2.5%).

Sectors	Value of exports (qxw)			Value of imports (qim)			Domestic output (qo)		
	Pre	Post	Change	Pre	Post	Change	Pre	Post	Change
Textiles	1162	887	-274	10183	8610	-1573	10600	10233	-367
Apparel	28019	23514	-4505	459	412	-46	28400	23903	-4498
Leather	1122	968	-154	492	417	-75	2659	2560	-100
Fish	79	75	-5	70	67	-3	10674	10667	-7
Other Manufacturing	833	746	-87	26599	24390	-2209	33599	36673	3073
Service	317	281	-36	2570	2370	-200	173314	174531	1217
Agri & Food	1522	1331	-191	8281	7568	-713	75094	75659	565

Source: GTAP database CGE simulation results. Figures in million US\$.

Table 9. Trade effects due to trade disruptions during COVID-19 (Trade costs) at a high level (5%).

Sectors	Value of exports (qxw)			Value of imports (qim)			Domestic output (qo)		
	Pre	Post	Change	Pre	Post	Change	Pre	Post	Change
Textiles	1162	613	-549	10183	7037	-3146	10600	9865	-735
Apparel	28019	19010	-9010	459	366	-93	28400	19405	-8995
Leather	1122	814	-307	492	342	-150	2659	2460	-199
Fish	79	70	-10	70	64	-6	10674	10659	-14
Other Manufacturing	833	659	-174	26599	22181	-4418	33599	39746	6146
Service	317	246	-71	2570	2170	-400	173314	175747	2433
Agri & Food	1522	1140	-381	8281	6855	-1425	75094	76224	1130

Source: GTAP database CGE simulation results. Figures in million US\$.

Tables 7, 8, & 9 summarize the CGE analysis results of trade disruptions caused by higher trade costs due to the COVID-19 pandemic at low, medium, and high levels, respectively. The analysis indicates that trade disruptions substantially reduce exports and imports across all sectors in Bangladesh. The apparel sector experiences the highest decline in export value (\$2,702.89 million), followed by textiles (\$164.63 million) and agriculture and food (\$114.39 million). The negative impact on other sectors' exports is comparatively lower.

In the case of imports, the effects of trade disruptions caused by the pandemic in Bangladesh are highest for other manufacturing sectors (\$1325.52m), followed by textiles (\$943.9m), agri & food (\$427.58m), and service (\$119.95m) sectors. The results suggest that the effects of trade disruptions on exports and imports are higher in sectors with higher export and import values than in other sectors. The impacts of trade disruptions on domestic output are also prominent. Trade disruptions reduce domestic output in the apparel (\$2698.65m), textiles (\$220.44m), leather (\$59.75m), and fish (\$4.33m) sectors. In contrast, trade disruptions increase domestic output in other manufacturing (\$1843.93m), service (\$730m), and agri & food (\$338.96m) sectors. The CGE analysis results at medium and high-level shocks suggest that the effects of trade disruptions intensify as the level of shocks increases.

Table 10. Trade effects due to both demand shock and trade disruptions during COVID-19 at a low level (1.5%).

Sectors	Value of exports(qxw)			Value of imports (qim)			Domestic output (qo)		
	Pre	Post	Change	Pre	Post	Change	Pre	Post	Change
Textiles	1162	991	-170	10183	9215	-968	10600	10357	-243
Apparel	28019	25165	-2854	459	432	-27	28400	25550	-2851
Leather	1122	1022	-100	492	449	-43	2659	2595	-65
Fish	79	76	-4	70	69	-1	10674	10688	14
Other manufacturing	833	775	-58	26599	25343	-1256	33599	35404	1805
Service	317	294	-23	2570	2456	-114	173314	174078	764
Agri & food	1522	1397	-125	8281	7887	-393	75094	75546	451

Source: GTAP database CGE simulation results. Figures in million US\$.

Table 11. Trade effects due to both demand shock and trade disruptions during COVID-19 at the medium level (2.5%).

Sectors	Value of exports(qxw)			Value of imports (qim)			Domestic output (qo)		
	Pre	Post	Change	Pre	Post	Change	Pre	Post	Change
Textiles	1162	874	-288	10183	8553	-1630	10600	10180	-420
Apparel	28019	23161	-4858	459	415	-44	28400	23548	-4852
Leather	1122	950	-172	492	422	-70	2659	2548	-111
Fish	79	73	-7	70	68	-2	10674	10709	35
Other manufacturing	833	732	-101	26599	24552	-2047	33599	36582	2982
Service	317	278	-39	2570	2384	-185	173314	174609	1295
Agri & food	1522	1307	-214	8281	7648	-633	75094	75921	827

Source: GTAP database CGE simulation results. Figures in million US\$.

Table 12. Trade effects due to both demand shock and trade disruptions during COVID-19 at a high level (5%).

Sectors	Value of exports(qxw)			Value of imports (qim)			Domestic output (qo)		
	Pre	Post	Change	Pre	Post	Change	Pre	Post	Change
Textiles	1162	1114	-48	10183	9972	-211	10600	10454	-146
Apparel	28019	27022	-997	459	462	3	28400	27400	-1001
Leather	1122	1075	-46	492	499	7	2659	2626	-33
Fish	79	75	-5	70	71	1	10674	10755	81
Other Manufacturing	833	791	-42	26599	26836	237	33599	33527	-72
Service	317	310	-7	2570	2607	37	173314	173615	301
Agri & Food	1522	1458	-64	8281	8381	100	75094	75631	537

Source: GTAP database CGE simulation results. Figures in million US\$.

The CGE model also analyses the combined effects of both demand shock and trade disruptions on the trade performance of Bangladesh, and the analysis results are summarized in Tables 10, 11, and 12. The analysis results indicate that the combined effects of both demand shock and trade disruptions are higher than their individual effects in all sectors in Bangladesh. Finally, the study analyses the actual exports and imports of different sectors during and post-pandemic periods to cross-validate the simulated effects of the shocks using the CGE model. The export data summarized in Tables 13 and 14 suggest that the export performance of different sectors of Bangladesh during the pandemic is mixed.

The export performance of the textiles sector during the pandemic is good enough. Although CGE simulated analysis shows that the export of the textiles sector will reduce substantially, the actual data shows an increase in textiles export of Bangladesh in 2020 by \$124.16m. The apparel sector experienced a high decrease in exports (\$5372.64m), which is also supported by the results of the simulated analysis. It infers the export of the apparel sector in Bangladesh is substantially affected by the shocks during the Covid-19 pandemic. Other sectors that are highly impacted by the pandemic are service and other manufacturing sectors. These sectors experience a very high fall in export value compared to the fall of exports in these sectors, as suggested by the CGE simulation results. The agri and food sectors performed well during the pandemic. The fall in exports of these sectors is low compared to the decrease suggested by the CGE analysis.

Table 13. Export performance of Bangladesh during COVID-19.

Sectors	Export (Million US\$)			Export growth			Export volume Change (in million US\$)	
	2018	2019	2020	2018	2019	2020	2019	2020
Textiles	1985.8	1936.2	2060.4	0.12	-0.03	0.06	-49.5	124.2
Apparel	38902.2	40570.0	35197.3	0.13	0.04	-0.13	1667.8	-5372.6
Leather	471.4	506.4	375.0	0.14	0.07	-0.26	35.0	-131.4
Fish	77.9	74.2	43.5	0.05	-0.05	-0.41	-3.7	-30.8
Other manufacturing	2623.2	2843.8	2539.8	0.56	0.08	-0.11	220.5	-304.0
Service	5446.1	6213.7	6019.8	0.29	0.14	-0.03	767.6	-193.9
Agri & food	852.9	982.8	952.5	0.63	0.15	-0.03	129.9	-30.3

Source: Data collected from <https://oec.world/en/profile/country/bgd/>. Figures in million US\$.

Table 14. Import performance of Bangladesh during COVID-19.

Sectors	Import (Million US\$)			Import growth			Imports volume change (in million US\$)	
	2018	2019	2020	2018	2019	2020	2019	2020
Textiles	13490.7	12624.3	10524.6	0.18	-0.06	-0.17	-866.4	-2099.7
Apparel	230.2	211.9	213.3	-0.14	-0.08	0.01	-18.4	1.4
Leather	241.5	218.8	166.0	-0.12	-0.09	-0.24	-22.7	-52.8
Fish	5.5	7.2	5.0	0.61	0.31	-0.31	1.7	-2.2
Other manufacturing	35369.5	35899.9	29140.7	0.14	0.02	-0.19	530.4	-6759.2
Service	9619.2	9557.8	7926.6	0.13	-0.01	-0.17	-61.4	-1631.2
Agri & food	7016.9	7594.1	8462.2	0.08	0.08	0.11	577.3	868.1

Source: Data collected from <https://oec.world/en/profile/country/bgd/>. Figures in million US\$.

The import performance data of Bangladesh also provides crucial insights. The results support the fall in imports from the textile sector. Although CGE results suggest a decrease in apparel imports, the actual data shows an increase in apparel imports by \$1.40 million. Imports of other manufacturing sectors drastically fell due to shocks caused by the pandemic, and the CGE analysis results also suggest this high decrease. Service imports also substantially dropped during the pandemic, and simulated results also suggest a high fall in imports in the service sector. The import data on the agriculture and food sectors drastically contradict the proposed simulated results. Although CGE simulated results suggest a substantial reduction in the agriculture and food imports in Bangladesh due to shocks caused by the COVID-19 pandemic, the actual data suggest a high increase in the import of the agriculture and food sectors in Bangladesh.

The study's findings offer important new information about how COVID-19 has affected Bangladesh's exports and imports. The findings are consistent with hypothesis 1, which suggests that Bangladesh's export, import, and output are significantly impacted by the demand and supply shocks caused by the COVID-19 pandemic. The findings also imply that supply shocks from trade disruptions have a much greater impact than demand shocks. The analysis indicates that different shocks have varying effects on trade and output at different levels. Shocks have a greater effect on trade and output when their intensity is higher. Therefore, the study's findings support the second hypothesis. Additionally, the findings suggest that different sectors are affected differently by COVID-19 shocks. The simulation results show a significant decline in exports across all industries. However, actual data reveals that some industries, particularly textiles, performed well and experienced an increase in exports during the pandemic. The study's findings also support the third hypothesis.

5. CONCLUSIONS

The COVID-19 epidemic brought attention to the weaknesses of the world's supply chains due to the lack of raw materials, the interruption of manufacturing and travel, and social alienation. The pandemic has had a massive impact

on trade and exports from Bangladesh in different ways. The pandemic caused problems that impacted supply and demand, making it more challenging to respond effectively. The increased load of COVID-19 on Bangladesh inevitably reduced the industry's size, which lowered export supply. A commodity's domestic demand as well as production was affected by the COVID-19 pandemic. The pandemic significantly impacted the Bangladeshi economy as numerous important economic indices were already in decline.

The purpose of this study is to determine how the COVID-19 pandemic's effects on supply and demand impact Bangladesh's exports and imports. The study uses descriptive data to identify possible trade scenarios for Bangladesh during the pandemic. A computable general equilibrium (CGE) model is then used to determine simulated trade scenarios for various sectors under different levels of shocks. Finally, it assesses Bangladesh's trade performance during the pandemic by contrasting the simulated results with actual trade data. The study applies the GTAP 10 database and analyzes the effects of different levels of demand shocks and trade disruptions caused by trade costs due to the COVID-19 pandemic on export, import, and output during the pandemic, comparing them with actual data. As proposed by previous studies, this study assumes private consumption (as a proxy for demand shock) declines by 2%, 3.5%, and 5% under low, medium, and high scenarios, respectively, and trade costs (as a proxy for trade disruptions) increase by 1.5%, 2.5%, and 5% in the low, medium, and high shock scenarios, respectively.

The results of the study suggest that both demand shocks and trade disruptions substantially affect Bangladesh's export, import, and domestic output during the pandemic. According to analysis results from CGE modeling, Bangladesh's export, import, and output were all significantly impacted by demand shocks and trade disruptions. Additionally, it is found that output and trade are affected differently by shocks of various intensities. The findings also imply that the pandemic's shocks have a variety of effects on different industries. The shocks significantly impact some sectors while having little effect on others. The CGE model also analyzes the combined effects of both shocks on Bangladesh's trade performance. The analysis results indicate that the combined effects of demand shocks and trade disruptions are higher than their individual effects across all sectors in Bangladesh. The actual export and import data cross-validate the CGE analysis results and provide mixed findings on the trade performance of various sectors during the COVID-19 pandemic.

The study's findings offer vital policy insights. The findings show that the COVID-19 pandemic's demand and trade shocks have a significant impact on Bangladesh's exports and imports. Given that Bangladesh's economy is heavily dependent on exports and imports, appropriate measures should be taken to offset the effects of shocks on Bangladesh's trade and output. The study's findings support that both shocks at various intensity levels affect Bangladesh's exports and imports differently. As a result, if the economy experiences additional shocks, appropriate policies should be developed. The study's findings also make it clear that demand shocks and trade disruptions affect trade and output in various ways depending on the sector.

Funding: This research was funded by the UGC Research Grant, University of Dhaka, Grant Number: 2020-2021.

Institutional Review Board Statement: Not applicable.

Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.

Competing Interests: The authors declare that they have no competing interests.

Authors' Contributions: Both authors contributed equally to the conception and design of the study. Both authors have read and agreed to the published version of the manuscript.

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