

Original Article

How does Country Development Affect the Logistics Activities During the Covid Pandemic

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Abstract - Logistics are considered the backbone of an economy. If this system is interrupted by an external shock, the economy will be affected severely. Such as Covid pandemic occurred in 2019, the logistics activities were blocked, and the economy was downed turn. Therefore, an economy needs to build a good logistics system to develop sustainably. This paper finds out that a country's development level affects the logistics system, as the way higher the income level, the more logistics activities. Especially when a shock occurs, the less income, the more severe the effect on the logistics system.

Keywords - Air freight, COVID-19, Logistics activities, Income level.

1. Introduction

Recently, many researchers have focused on topics related to logistics activities. The reason attracting many researchers is its key role in economic development. Logistics activities connect the providers and consumers more effectively; they help companies reduce and save costs and get more benefits. The richer firms, in turn, invest more in logistics activities. The country level also has the same relationship between economic growth and logistics activities at the firm level. The economic growth may impact the logistics industry positively [1]. The other determinants impacting the logistics activities of a country can be listed as institutional reforms related to the level of corruption and stable political environment and upgrading resources such as infrastructure, technology, labour, and education [2]. The logistics sector can also be impacted by taxation, inflation, and GDP, whereas two previous factors have a negative impact, and the last factor has a positive impact [3]. The logistics activities face many risks at the level of the country. Those risks can be divided into three kinds: likely financial risks, corruption risks and political risks [4].

The COVID-19 pandemic also is a risk or a shock for logistics activities. With the risk that cannot be predicted, like COVID-19, the impact of it is extremely severe for all sectors of the world, whereas the logistics sector is unexcepted. All the global transportation segments, including ocean, land, and air, reduced their freight, whereas air freight reduced the most (19% in March 2020 due to a sharp reduction in passenger flights) [5]; for the global economy, IMF was predicting a 3 percent contraction in 2020 [6]. The uncertainty and changes in the operational environment, such as COVID-19,

negatively impact business development in the logistics sector [7]. COVID-19 affects all the processes of logistics and supply chain. It causes the efficiency of all business performance to be reduced [8]. The risk from a pandemic such as COVID-19 results in unpredicted consequences. Therefore, many researchers are trying to discover many logistics features impacted by COVID-19. [9], [10] and [11] focus on the effect of Covid on transportation, while [12] and [13] find out the effect of COVID-19 on the logistics sector.

Logistics are considered the backbone of an economy. It helps connect the economic activities more effectively. The roles of logistics sectors in economic growth are proven in many researches. [14] finds out that the transportation and communication industries both facilitate economic growth based on OECD data. However, [15] investigates that the positive relationship running from the logistics sector to economic growth depends on the variables proxy for the logistics sector. Other researches that determine logistics' role in economic growth are [16] and [17].

However, the reverse relationship between development and the logistics sector does not do much research. [18] and [19] use the integration model to determine the co-integration between logistics and economic growth. They find a positive relationship running from development to logistics. Especially how better logistics help an economy over a shock likely COVID-19 research is quite rare. Therefore, a question is asked if an economy has a better logistics system, it can overcome shocks such as COVID-19 better than other economies, or its scale of damage is less than other economies.



To find out how country development affects logistics activities during covid pandemic, we use the data from 2000 to 2021 of all countries and economies worldwide. The logistics activities are proxied by the air freight that measures the volume of the volume of freight, express, and diplomatic bags carried on each flight stage; the classification of countries based on income level; Gross Domestic Growth (GDP); and the Consumer Price Index (CPI). These data are downloaded from the World Bank and IMF.

First of all, we find the Covid pandemic effect on air freight. It causes a reduction in the volume of air freight. To be more accurate, the Covid effect is separated into each year after it occurred. The results are confirmed. Then, we add the development of an economy into the model to find out how this feature impacts logistics activities. The country's development is divided into four groups: high, upper-middle, lower-middle, and low-income groups. The estimated results show that the more development, the greater the logistics activities. That means a more developing country has a greater volume of air freight.

Finally, we add the interaction term between Covid and the level income of an economy to find out how country development affects the logistics activities during the covid pandemic—the lower income level results in a greater Covid effect on air freight. The low-income group is affected the most severely by COVID-19. The reduction of air freight between before and after this group is about 493%. The air freight of the lower-middle-income group is reduced by 280%. Then 218.35% is the upper-middle-income group's air freight reduction scale by COVID-19. Moreover, the lowest air freight effect of Covid is the high-income group; the reduction is only about 39.5%.

Besides the Introduction part, the structure of this paper is as follows: Part II is the data description; Part 3 is the model used to investigate how country development affects the logistics activities during covid pandemic; Part 4 is the estimated results; and last part is the conclusions.

2. Data and Methods

2.1. Data

To investigate how logistics activities are interrupted by COVID-19, this paper uses some data such as air freight, the Gross Domestic Product (GDP), and the Consumer Price Index (CPI) from 2000 to 2021. The air freight is a proxy to the logistics activities, a downed load from the World Bank.

Air freight is the volume of freight, express, and diplomatic bags carried on each flight stage (operation of an aircraft from takeoff to its next landing), measured in metric tons times kilometers traveled. CPI reflects changes in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals. The interval in this paper is yearly.

GDP can be found in the International Monetary Fund (IMF). The unit of GDP is a million USD. GDP proxies the size of an economy and the demand of an economy.

The air freight from 2000 to 2021 of the economies from all over the world is presented in Fig.1. In this Figure, this data is divided into 4 categories following the development of an economy. The development of an economy is classified based on income, including low-income, lower-middle-income, upper-middle-income and high-income. An economy classified in one of four levels changes over time because it depends on the level of its income in each period—this data is from the World Bank. The air freight has increased over time. However, it decreased in 2020 for all levels of development when COVID-19 occurred. In 2021, the air freight recovered, but still lower compared with some previous years.

From Figure 1, we can see the different air freight among economies. The high-income group's air freight is greater than all other groups' once. The air freight of this group is even greater than the amount of air freight of the three other groups.

2.2. Methods

Firstly, we investigate the COVID-19 effect on logistics activities. To capture this effect, the paper uses Equation 1 as follows:

$$\ln A F_{it} = \beta_0 + \beta_1 \ln G D P_{it} + \beta_2 \ln C P I_{it} + \beta_3 C O V I D_{it} + \gamma_i + \delta_t + \varepsilon_{it} \quad (1)$$

Where $\ln A F_{it}$ is the natural logarithm of the air freight of country i at year t ; $G D P_{it}$ is the gross domestic products of country i at year t ; $C P I_{it}$ is the consumer price index of country i at year t ; $C O V I D_{it}$ is a dummy variable taking the value of one after year t (after 2020) and zero otherwise; γ_1 and δ_t is the country fixed effect and year fixed effect; ε_{it} is the error term.

This paper also finds out how the level of development of countries affects the logistics activities and how they deal with the effects of COVID-19. To do so, we use Equations 2 and 3.

$$\ln A F_{it} = \beta_0 + \beta_1 \ln G D P_{it} + \beta_2 \ln C P I_{it} + \beta_3 C O V I D_{it} + \beta_4 C L A S S_{it} + \gamma_i + \delta_t + \varepsilon_{it} \quad (2)$$

$$\ln A F_{it} = \beta_0 + \beta_1 \ln G D P_{it} + \beta_2 \ln C P I_{it} + \beta_3 C O V I D_{it} + \beta_4 C L A S S_{it} + \gamma_i + \delta_t + \varepsilon_{it} \quad (3)$$

Where the other notations in Equations 2 and 3 are the same as in notations in Equation 1, we add a dummy $C L A S S_{it}$ variable in Equation 2, which represents the level development of economy t in year t and takes four values from 0 to 3.

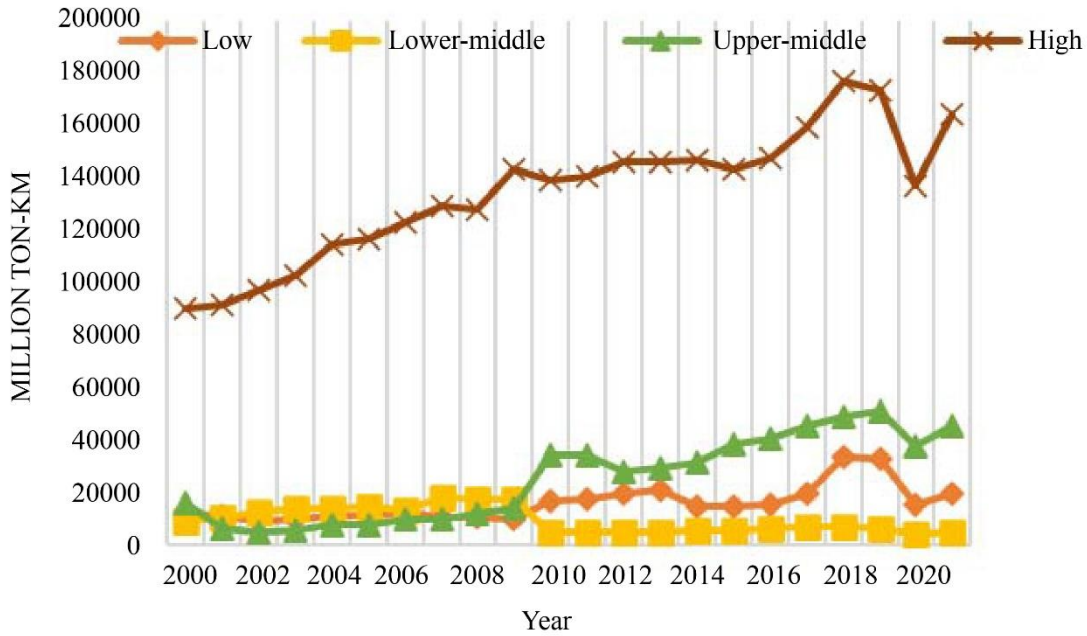


Fig. 1 The air freight of the world from 2000 to 2021

Before investigating how COVID-19 interrupts logistics activities, we look at the summary data provided in Table 1.

Table 1. Summary data from 2000 to 2021

Variable	Obs	Mean	Std. Dev.	Min	Max
lnAF	2,383	3.784591	3.466244	-9.358377	10.7365
lnCPI	2,507	4.653125	.3992206	2.707471	9.695595
lnGDP	2,507	13.68894	3.185378	5.530794	24.81885
CLASS	2,507	1.781811	1.069726	0	3

Note: ln is natural logarithm; AF is the air freight.

It takes the value of 3 if an economy is classified as a high-income country level in year t ; otherwise 2, 1, and 0 for upper middle, lower middle and low income, respectively. Moreover, the dummy $COVIDCLASS_{it}$ variable in Equation 3 represents the interaction between countries' income levels and COVID-19.

It takes the value of 0 if country i is a low-income country level before COVID-19 occurred, 1, 2, 3 for a country belonging to lower-middle, upper-middle and high-income country level before COVID 19, 4, 5, 6, and 7 for those countries belong to lower-middle, upper-middle and high-income country after Covid19 occurred.

3. Estimated Results

When COVID-19 occurred, many economies were blocked down in the world. The movement among countries did not allow. That process is not only maintained among borders of nations but also among states or provinces in a country, even among homes in one area. People had to stay home to avoid infection; therefore, the transportation system had been severely affected. That effect is captured by $[[COVID]]_{it}$ in Equation 1.

Running Equation 1, the estimated results of this pandemic effect are provided in Table 2, lnAF (1). COVID-19 causes the breakdown of breaking down the transportation system, including air transport. The estimated results show that after COVID-19 happened, air freight was negatively significantly impacted, and the size of this effect is approximately 308%. Besides, the size of economies and CPI also significantly positively affect air transport. If the size of economies increases, the size of air transport carriers increases (about 0.62%). Conversely, the effect of CPI is significantly negative, affecting the level of air freight (about 0.55%). That means when the CPI increases, the consumers reduce their consumption and vice versa.

Now, we investigate the size of COVID-19's effect on air transportation each year after it occurred. From Equation 1, we add COVID2020 and COVID2021 and drop the COVID variables. The estimated results of each year after COVID-19 occurred are provided in Table 2, lnAF(2). COVID-19 still negatively impacts logistics activities; it causes reductions in the volume of freight, express, and diplomatic bags carried on each flight stage. The effect of COVID-19 in 2021 on freight volume is greater, about 11.29%, than in 2020. Other variables still significantly impact the air freight.

Table 2. The effect of COVID-19 on logistics activities

	(1)	(2)
VARIABLES	lnAF	lnAF
lnGDP	0.618***	0.618***
	(0.138)	(0.138)
lnCPI	-0.548***	-0.548***
	(0.186)	(0.186)
COVID ₂₀₂₀		-1.299***
		(0.179)
COVID ₂₀₂₁		-1.406***
		(0.186)
COVID	-1.406***	
	(0.186)	
Constant	-1.451	-1.451
	(1.156)	(1.156)
Year-fixed effect	YES	YES
Country- fixed effect	YES	YES
Observations	2,383	2,383
R-squared	0.921	0.921

Note: Standard errors are in parentheses; ***, **, and * are significant at 1%, 5%, and 10%, respectively; lnGDP and lnCPI is the natural logarithm of GDP and CPI, respectively; COVID is dummy variable; the coefficients of year-fixed effects, country-fixed effects are omitted for briefly.

We investigate how a country's development affects logistics activities using Equation 2. In this model, we still capture the effect of COVID-19 on the logistics activities under the COVID variable, and we add the CLASS variable to capture the country's development effect on logistics activities. The estimated results are provided in Table 3, lnAF(1). GDP and CPI still significantly impact air freight, and COVID-19 still negatively impacts air freight. With the development level of a country, the more developed a country is, the greater the volume of freight, express, and diplomatic bags carried on each flight stage a country carries. The lower-middle income effect on air freight is about 15% greater than the low income; the upper-middle income effect on air freight is about 15.23% greater than the lower-middle income; and the high-income effect on air freight is about 13.66% greater than the upper-middle income. Although all coefficients are positive, only the high-income effect on the logistics activities is significantly greater than the low-income on logistics activities.

Now, we compare the effect of country development on the logistics activities before and after the COVID-19 pandemic by adding the interacting variable between COVID and CLASS. The estimated results are provided in Table 3, lnAF(2). Based on those results, we still confirm that the level of the country's development impacts differently on the logistics activities. Before the Covid pandemic, the greater the country's development level, the greater the the effect on the logistics activities. With this model, the effects are significantly positive for both upper-middle and high-income

groups. The high-income group's impact on air freight is about 9.56% greater than the upper-middle group based on Model 3. The effects of covid on the air freight of all groups are significantly negative but are extremely different among them. Firstly, we compare the effect of Covid on one group's air freight between before and after the pandemic. Then, we compare the effect of COVID-19 on air freight among groups.

Table 3. The development of an economic effect on logistics activities during the Covid pandemic

	(1)	(2)
VARIABLES	lnAF	lnAF
lnGDP	0.539***	0.565***
	(0.146)	(0.146)
lnCPI	-0.472**	-0.432**
	(0.192)	(0.192)
COVID	-1.408***	
	(0.187)	
CLASS=1	0.140	
	(0.126)	
CLASS=2	0.282	
	(0.177)	
CLASS=3	0.410*	
	(0.240)	
COVIDCLASS=1		0.136
		(0.127)
COVIDCLASS=2		0.318*
		(0.179)
COVIDCLASS=3		0.412*
		(0.240)
COVIDCLASS=4		-1.780***
		(0.359)
COVIDCLASS=5		-1.471***
		(0.263)
COVIDCLASS=6		-1.476***
		(0.286)
COVIDCLASS=7		-0.745**
		(0.308)
Constant	-0.709	-1.206
	(1.240)	(1.250)
Year-fixed effect	YES	YES
Country- fixed effect	YES	YES
Observations	2,383	2,383
R-squared	0.921	0.921

Note: Standard errors are in parentheses; ***, **, and * are significant at 1%, 5%, and 10%, respectively; lnGDP and lnCPI are the natural logarithm of GDP and CPI, respectively; COVID is a dummy variable representing for COVID 19 impaction on the air transport; CLASS is dummy variable representing for the effect of a country development on the air transport; COVIDCLASS is dummy variable representing for the effect of a country development before and after Covid on the air transport; the coefficients of year-fixed effects, country-fixed effects are omitted for briefly.

The most severe effect is the low-income group. The difference effect of Covid on the air freight of this group is very large. The volume of freight, express, and diplomatic bags carried on each flight stage was reduced by 493% compared with the volume before the pandemic. After the low-income group is the lower-middle group. Covid pandemic caused a reduction in air freight in the lower-middle group. The size of this reduction is about 280%. The Covid pandemic also reduced the air freight volume for the upper-middle group; however, the size of the reduction is lower than the two previous groups. From the estimated results in Table 2, we can calculate this sign equals 218.35%. Compared with other groups, the Covid effect on this group's air freight is the least, about 39.5%.

4. Conclusion

When an economy develops, it has opportunities to invest other resources to strengthen the economy. In digital century 4.0, logistics has been among the fastest-expanding sectors, and governments place many priorities on developing this industry. Knowing the factor affecting the logistics activities

help not only an economy build up a good logistics system but also a business partner choosing a good market having a good logistics system. That helps business processes not interrupt or recover rapidly after an external shock.

The logistics activities are affected by the level of development of a country. If a high-income level meets an external shock, it is easy to recover from that, or the size of the effect of this shock on the logistics activities is less than the other countries. Therefore, it can return back the productive process more rapidly than the others.

This finding also suggests that trading with developed economies helps traders ensure more if a shock happens because it seems harder to be interrupted than in other economies.

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