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Evaluation of the Effects of Air Cargo Transportation on Global Competitiveness

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Abstract

Global competitiveness has become just as crucial in the rapidly growing world economy. For this reason, the problem of delivering the products to the consumer at the right place and time has become indispensable to survive in the global market and has brought the logistics factor to the fore. One of these logistics activities, the transportation sector, ensures that human needs are met at the desired place and on time. It has become essential to deliver products to target markets faster and safer than their competitors, and airplanes have been used in cargo and passenger transportation. The rapid technological change has also led to aircraft development used in cargo transportation. Thus, air cargo transportation, which is less risky and faster than other transportation modes, has come to the fore in time-bound and valuable goods. The main purpose of this study, which is carried out with the qualitative research method, is to determine and evaluate the effects of air cargo transportation on global competitiveness. In the study, firstly, the concept of air cargo transportation tried to be explained. Then, the literature review created the background of the study. In this context, the development process of air cargo transportation was discussed in terms of its historical, corporate, and economic development. Then, the types of aircraft used, airports, and cargo companies operating on a global scale, which are the elements of air cargo transportation, were examined. In addition to the high capacity and fuel efficiency produced by the current technology of the aircraft, the issue of further reduction of costs due to capacity increase by optimizing the loading problem has been mentioned. Finally, by analyzing the findings, the effects of air cargo transportation on global competitiveness were discussed and evaluated, and suggestions were made to increase this power. This article, which is a direct study on the effects of air cargo transportation on global competitiveness, is crucial as it will contribute to the literature.

1. Introduction

The world is in constant change in terms of economy and many aspects. The main goal of economic change is the creation of a single and integrated world economy. Many factors, such as cultural changes, and technological innovations created by urbanization in this process, differentiate the needs of individuals day by day. This situation has also affected world trade, which led to the disappearance of trade borders between countries and to significant increase in global competition. In this competitive environment, the efforts of countries to exist in the worldwide market have brought along new searches. At the beginning of these are the logistics activities that meet the goods and services people need at the desired place and time under appropriate conditions. Therefore, success in logistics activities will also bring success in international trade. In this context, the importance of logistics activities and the logistics industry is increasing day by day and is becoming an essential driving force of global trade. Today, products designed in any geographical region of the world are produced in different geographical areas and are demanded from other parts of the world. For this reason, the "speed" factor, which is vital in the functioning of logistics, has become one of the prerequisites for competitiveness in global trade.

Each mode of transport used to transport products subject to global trade has advantages and disadvantages. However, according to the severity and urgency of the requested product, air cargo transportation comes to the forefront due to certain benefits such as time, space, and security. With air cargo transportation, which is far from many limitations that influence other transportation modes, perishable, high-value products can be transported to the most extended distances quickly and safely. Due to its importance in the global supply chain, the demand for air cargo transportation increases despite its high cost compared to other transportation modes.

Humankind, who has been trying to fly like birds since the past times, has started to use the airline first in wars and then in trade after succeeding in this. Air transport, which is the most modern form of logistics offered by the developing technology, has started to be used as passenger transport in commercial activities. Its use in cargo transport activities has

been somewhat delayed. Cargoes were initially carried with passengers. The development of the aircraft manufacturing industry in parallel with technological developments, enabled the manufacturing of passenger aircraft with cargo sections and of aircraft with cargo only. Thus, the demands for air cargo transportation tried to be met.

Businesses that can offer their products quickly in today's logistics environment have a competitive advantage in the global market. In this sense, air cargo transportation serves these purposes of businesses in world trade, where the importance of fast and safe service provision increases daily. Thus, the share of air cargo transportation in products transported in international trade increases. Success in this field will enable countries to achieve success in foreign trade.

The study is vital in laying the groundwork for future studies by examining the development process of air cargo transportation, which has the potential to affect world trade but is still thought to be not where it should be. In this context, aircraft, airports, and airline cargo companies, which are in close relationship with each other in the service delivery of air cargo transportation, which is a service production, have been examined in the historical process, and a perspective has tried to be put forward. In line with these examinations, the effects of air cargo transportation on global competitiveness in the rapidly globalizing world were determined and evaluated.

2. The Concept of Air Cargo Transportation

Before discussing the concept of air cargo transportation, it would be appropriate to define the concepts of transportation and cargo as a basis. As with the definition of many concepts, there are also differences in the definition of transportation. The first of the generally accepted definitions of transportation was expressed by Black (2003:3) as the movement of people and goods from one place to another. However, Hensher (2004:309) emphasized that this definition would be incomplete if the information were not added because it would not be possible to manage, support, and expand the movement of goods and people. With truly accurate information, it will be possible to save time, manage inventory and choose between supply chains. On the other hand, Kasilingam (1998:157), who examines transportation in terms of the production-consumption relationship, stated that the connection between production, storage, and consumption could only be achieved through transportation. Therefore, it is seen that the benefits of time and place come to the fore in the main transportation definitions mentioned (Çancı & Erdal, 2013:5).

The concept of cargo was defined in The Dictionary of Transport and Logistics prepared by Lowe (2002:33), with a general expression, primarily as a word used instead of freight in the shipping and air freight sectors. However, today, this concept is interpreted as a separate cargo from the goods carried under postal freight or international postal agreements and the baggage carried by the passenger. In summary, baggage that is not accompanied and is transported by issuing a bill of lading is defined as cargo (Öktem, 1992:9).

After the various definitions are given above, when the concept of transportation is reduced to the airline specifically, air transportation is defined as the displacement of people, goods, or mail with an aircraft, regardless of the purpose of transportation (Gerede, 2002:9). Air cargo can be defined as transporting goods from one place to another by aircraft (Allaz, 1998:8). In a broad sense, the term air cargo includes air freight, postal and other packages sent for any purpose. In a narrow sense, everything other than departing passenger baggage in a passenger aircraft's cargo compartment is considered air cargo. In other words, since passenger baggage is regarded as a part of the passenger, it is not included in this scope (O'Connor, 2000:271). Based on the definitions so far, depending on the ICAO (International Civil Aviation Organization) and IATA (International Air Transport Association) rules, and taking into account the country and carrier restrictions, air cargo transportation can be defined as the packaging of goods (excluding mail and baggage), labeling, proper preparation of documents, and dispatch by an aircraft (Turşucu, 1995:38). ICAO and IATA are two international organizations working to standardize aviation rules apart from international agreements and national legal regulations.

Air cargo transportation, a sub-market of air transportation, ensures that goods with low volume and weight but high value are delivered to their destination more quickly and safely than other modes of transportation. This is an essential feature in terms of competition. In addition, Taneja (2003:139-140) states that air transportation, which was preferred at first because it provides speed, reliability, and advantages in the transportation of fragile/perishable products, is preferred due to more logistics support as a result of rapidly changing consumer expectations today. He also states that this minimizes transportation costs and reduces distribution costs. In this context, the tendency for air cargo transportation, which is newer than other modes of transportation, to be preferred by the actors in the global trade market is increasing, and its development is accelerating. The rapid increase in demand for the sector has enabled the production of aircraft used in air cargo transportation with technology development. It has started to play an essential role in international trade.

Cargoes subject to air cargo transportation are classified because they have their characteristics. In this framework, the loads carried are generally classified in two ways. First, the classification made according to "the wishes and needs of the sender regarding the transportation service" is classified under three sub-headings "urgent cargo," "routine perishable cargo," and "routine non-perishable cargo." The second type of classification is according to the "characteristics of the cargo to be transported," which are classified as "general cargo," "special cargo," and "hazardous goods" (Kaya et al., 2012:93).

3. Literature Review

The rapid development of technology has emerged as an element that affects commercial life. The introduction of the internet into our daily lives in the 1990s has also changed our shopping habits. This change has occurred in both consumers and manufacturers, and the number of those who shop online has gradually increased. Thus, traditional transportation has introduced logistics as a new business line. In parallel with technological developments, air cargo transportation, one of the sub-branches of logistics, has also developed rapidly. As a result, research on logistics, which has become an area of interest since the end of the 20th century, has also increased. Although various studies were found in the literature review on air cargo transportation within the framework of the research subject, no direct research was found on the effects of air cargo transportation on global competitiveness. In this respect, the study is crucial as it will contribute to the literature. The literature review contributed to the formation of the study's theoretical background. Noteworthy studies in the reviewed literature are given in the table below:

Table 1. Literature Review

Author(s)	Period	Country/ Countries	Method	Findings
Akoğlu, B. & Fidan, Y. (2020)	-	Turkey	Qualitative Research Method	In the study, the world air cargo transportation sector was examined, and the place of Turkey's increasing capacity in the industry tried to be determined.
Aunurrofik, A. (2018)	-	Indonesia	Multiple Regression Analysis	The study examined the importance of air transport on regional development. It was concluded that the number of passengers and cargo carried by air had a positive and significant effect on regional per capita income. Moreover, this effect is more substantial in air cargo transportation.
Chang, Y-H. & Chang, Y-W. (2009)	1974-2006	Taiwan	Granger Causality Test	The causal relationship between air cargo expansion and economic growth was examined in the study. As a result, it was concluded that there is a long-term balance and bidirectional relationship between air cargo expansion and economic development.
Debbage, K. & Debbage, N. (2021)	-	-	Qualitative Research Method	The study aimed to understand better the changing role of air transport logistics in the modern global economy. For this, the historical evolution of global air transport, large cargo airports, airport logistics-centered growth theory focusing on the concept of aerotropolis, and the future challenges faced by the industry due to the complex and heterogeneous structure of the air transport logistics market were analyzed.
Demirbilek, A., Öz, S. & Fidan, Y. (2018)	2007-2016	Turkey	Qualitative Research Method	The study evaluated the relationship between the air cargo transportation system and the Logistics Performance Index in Turkey. As a result, it has been found that the adequate power of air cargo transportation in globalization is also reflected in the logistics performance index.
Emirkadı, Ö. & Balcı, H. (2018)	-	Turkey	Qualitative Research Method	The reflections of the rapidly developing logistics sector on Turkish foreign trade were evaluated in the study.
Gün, D. (2014)	-	Turkey	Qualitative Research Method	The study drew attention to the importance of logistics in air transportation in terms of time constraints and the quality of the materials used. In addition, it has been stated that airline companies will create value in the competitive market with the correct implementation of logistics strategies.
Nedeva, K. & Genchev, E. (2018)	2000-2016	Bulgaria	Data Processing Method with Gretl Program	The study examined the relationship between the development of air transport, the economic development of Bulgarian regions, and the improvement of competitiveness. It has been concluded that the development in air transport positively affects the region's competitiveness and stable socio-economic growth.
Sesliokuyucu, S.O., Sayar, G. & Polat, İ. (2019)	2017	28 European Countries	K-Means Cluster Analysis Method	The study examined European countries' regional and international relations in terms of international trade and aviation infrastructure variables. The findings showed that the nations gathered in two clusters, and all variables affected the formation of sets from different aspects.
Vega, H. (2008)	2000-2006	South America	Case Study	The results obtained in the study are consistent with the concerns of manufacturers that the competitive advantage gained due to low labor costs in the export of time-sensitive, perishable and exotic products will be lost due to the high air cargo costs.
Yuan, Low & Tang (2010)	1990-2006	Singapore, Hong Kong	ACSCOR Model	It has been shown in the study that the cargo traffic at an airport is significantly affected by the operating characteristics, the performances of the sub-air cargo and supporting logistics industry, and the economic environment in which it operates.
Zhang, A. & Zhang, Y. (2002)	-	USA, Asia	Qualitative Research Method	The study deals with a general discussion of various issues related to the liberalization of air cargo services in international aviation.

When considering the literature review in Table 1, it was observed that the studies were conducted for different countries and periods. It was also noted that the common focus of these studies, which were carried out using other methods for different subjects, is the increasing importance of air cargo transportation.

4. Method

The main purpose of this study, which was carried out with the qualitative research method, is to determine and evaluate the effects of air cargo transportation on global competitiveness. In the study, first, air cargo transportation tried to be explained. Then, the literature review created the background of the study. In this context, the development process of air cargo transportation was discussed in terms of its historical, corporate, and economic development. In addition, the types of aircraft used, airports, and air cargo companies, which are the elements of air cargo transportation, were examined. Finally, in line with the findings obtained from the reviewed literature, the effects of air cargo transportation on global competitiveness were determined and evaluated.

5. Development Process of Air Cargo Transportation

We can group aviation activities under two main categories, "civil aviation" and "military aviation," with a general distinction. It is possible to divide civil aviation into "air transportation" and "general aviation." Again, we can examine air transportation activities in "passenger transportation" and "cargo transportation." General aviation activities include non-scheduled private, commercial, sportive, balloon flights, and parachute flights. On the other hand, military aviation covers activities for combat, transport, reconnaissance and surveillance, unmanned aerial vehicles, and missiles (Ministry of Transport, Maritime Affairs and Communications, 2013:120). In this part of the study, the development process of air cargo transportation, the newest type of transportation that has proliferated in recent years, will be examined. Firstly, information will be given about air cargo transportation's historical, corporate, aircraft use, and economic development. Then, airports, which are one of the elements of air transport, will be examined.

5.1. Historical Development

The desire of humans to fly, which is as old as the history of humanity, is proved by the pictures that have survived from ancient civilizations to the present day (Ahipaşaoğlu & Arıkan, 2003:117). However, scientific studies on the desire to fly began in the Middle Ages. The first scholar working on this subject is known as Leonardo da Vinci. The flight principles of gliders and helicopters can be found in Vinci's drawings that have survived from 1505 (as cited in Arıkan, 1998:47). The Montgolfier Brothers carried out the first successful balloon flight in world aviation history over Paris in 1783 (Arıkan, 1998:47). Humankind's efforts to fly continued constantly. By 1903, the Wright brothers made the first flight with the first motorized and controllable aircraft they had invented, albeit for 12 seconds (as cited in Uğraç et al., 2020:1315). In 1909, the Frenchman Louis Bleriot became the first pilot to cross the English Channel by plane (Başol, 2012:9), and this went down in the history of world aviation as the first international flight (Long, 2012:167). The success achieved in the process that started with the dream of humankind to fly continued with the use of airlines on battlefields and trade.

Air transport, which was used only for passenger transportation initially, started to be used for cargo transportation later. The transportation of cargo by air began in 1910. The Americans took the first step in this process. Glenn Curtiss transported mail bags 240 km away in 2.5 hours. Fabric materials were transferred to 105 km on the passenger seat by another American company, Wright Company (as cited in Akoğlu & Fidan, 2020:33). Another successful trial in the United States that same year was the transport of 10 bales of silk from the Huffman Prairie Flying airport in Dayton to Columbus, Ohio. Following these innovations, the first air cargo transportation in Europe was in 1911 when the Berliner Morgenpost newspaper was moved from Berlin-Johannisthal to Frankfurt. Then, in 1918, regular air cargo transportation services were started between Washington DC and New York. Air cargo transportation, which began to become widespread in the 1920s, expanded with the establishment of larger airline companies and the production of large-capacity aircraft. For example, Ford Motor Company started to send its cargo through Henry Ford's Express airline company in 1925 (as cited in Ergin, 2020:5). Air postal service pioneered the establishment and development of today's air cargo transportation industry, primarily in the United States (USA).

There has also been an increase in air cargo trade, with large-capacity aircraft incorporated by larger airline companies established in the 1930s. After World War II, cargo operations increased faster with the manufacturing of larger and more efficient aircraft (as cited in Ergin, 2020:5). The production of Jumbo jet aircraft in 1970 increased the attention to air cargo transportation and has led to the growth of the global market in this sector (Akoğlu & Fidan, 2020:33). The use of air cargo transportation, which is relatively new compared to other transportation types in terms of its historical development process, has shown an increasing trend in general. However, it has decreased in some periods, as in the Covid-19 pandemic, and it is estimated that this trend will continue to develop in the future as well.

It can be said that global economic growth is roughly dependent on economic reforms, free trade agreements, and monetary unions. In this context, countries trying to ensure their national interests by joining large commercial blocs have dramatically changed the nature of international trade since the 1990s (Çelik, 2015:3). As a result, the variety of products subject to global trade has increased; parallel to this, competition has intensified, and business processes have been accelerated. To meet the needs above, air cargo transportation, which primarily carries goods with relatively low volume and weight, but with high economic value, has started to be preferred more as a dynamic sector due to its advantages (Çancı & Erdal, 2003:2). As it can be easily understood, companies or countries that compete or aim to compete globally will have to prefer air cargo transportation to meet their customers' fast and reliable delivery expectations.

5.2. Corporate Development

Aviation law historians state that the human beings who succeeded in flying started the regulations regarding the flight after the first balloon flight of the French Montgolfier brothers, which took off from Paris. After the Wright brothers first flew an engined aircraft, these regulation efforts came to the fore. Finally, the air navigation agreement signed between Germany and France on August 15, 1913, marked the beginning. Then, England in 1920, Germany in 1922, and France in 1924 promulgated air navigation laws. After these first regulations for aviation, air transportation spread and developed rapidly. Thus, the need to establish international regulations and rules for civil aviation has emerged (Battal et al., 2016:5).

In parallel with the developments in aircraft, problems began to arise about the air space dominance of the states. States have tended to make international regulations on air

transport by arguing within the framework of two opposing views. The first agreement made in this context was the Paris Agreement, signed by 27 states on October 13, 1919. Since all states did not accept this agreement, the Madrid Agreement was signed in 1926. Later, the 20 states that formed the Pan-American Union signed the Havana Agreement in 1928. The diversity of this agreement, which includes the basic principles of the Paris Agreement rules, gives more freedom to aircraft used for commercial purposes. The Warsaw Agreement, which determined the international rights and responsibilities of those engaged in civil air transport activities, was signed in 1929. Still, some of its articles were changed with the Hague Protocol in 1955. The purpose of the Chicago Convention, which genuinely guides aviation, is stated in the first declaration as "to prepare the necessary ground for establishing a safe and regular international civil aviation that targets equal opportunity and economic efficiency for the states parties." In this context, the countries participating in the conference signed the International Civil Aviation Agreement on December 7, 1944, to solve the existing and future problems in civil aviation. Under this agreement, the International Civil Aviation Organization (ICAO) was established and started. In addition to these, the 1933 Rome Agreement, the 1963 Tokyo Agreement, the 1970 Hague Agreement, and the 1971 Montreal Agreement were also signed. (Battal et al., 2016:5-7). With these listed agreements, international aviation rules have tried to be placed on a particular ground.

Aviation rules have been further developed by establishing international organizations other than the above-mentioned international agreements. FAR (Federal Aviation Regulations), which regulate the civil aviation rules of the United States of America, were created in 1970. JAR (Joint Aviation Requirements), which are the civil aviation rules of Europe, started to be designed by JAA (Joint Aviation Authorities) in 1990. Later in 2010, JAA was replaced by EASA (European Aviation Safety Agency), the civil aviation authority of the European Union. Founded by the countries participating in the Chicago Convention, ICAO was accepted as the Legal Aviation Body of the United Nations in October 1947. Established in Havana in 1945, IATA (International Air Transportation Association) aims to solve the commercial and political problems that member airline companies cannot solve (Battal et al., 2016:9-11). Issues that may occur or may arise in rapidly developing air transport operations can be prevented or resolved through these institutions.

Although air cargo transportation is a more costly mode of transportation than other transportation modes, the change in e-commerce and logistics strategies due to globalization has changed the perspective of enterprises on air cargo transportation. They have started to increase their cargo capacities (Popescu, 2006:1-2). The aforementioned strategic changes have increased the customers' expectations for faster and reliable delivery, especially for products with a short shelf life, and increased competition in air cargo transportation that meets these expectations. In this context, globalization and the development of international trade have brought air cargo transportation to the fore.

The emergence of air cargo transportation has given businesses the ability to hold less inventory. From the 1920s onwards, the volume of cargo carried by air increased. Thus, although there are initiatives such as Ford Company's express company, American Railway Express, National Air Transport, General Air Express, United Airlines, and Air Cargo Inc., which four major airline companies founded, airline companies operating only in this field started their activities after World War II. These companies, established under Slick, Flying Tiger, U.S. Airlines, and Airnews, could not achieve the success they wanted in their activities and were vanquished. Later, in 1964, major passenger airlines such as United Airlines started to offer intercontinental cargo services (U.S. Centennial of Flight Commission). Globalization, which has increased the volume and depth of trade and business relations since the last quarter of the 20th century, has also reshaped business organizations related to transportation. New business organizations aiming to meet global consumer demand cheaply, efficiently, and effectively highlight transportation approaches within the value-added chain (TOBB, 2012:66-67). Airline companies, which started their air transportation activities by carrying mail, have canalized to cargo transport, which has turned into an important market and passenger transport due to the sector's rapid technological and structural changes.

Boeing classifies air transport into four categories "All Cargo," "Combination Carrier," "Express Carrier," and "Passenger Belly Only" (Boeing World Air Cargo Forecast Team, 2020:18). The air cargo transportation sector has its characteristics, and ways of carrying cargo in the market can be considered four types of business: combined transportation, only cargo, door-to-door transportation, and intermediary air cargo businesses (Doganis, 2002:304-307). In addition, it can be divided into four different markets air mail, air express, courier, and air freight, depending on the services provided by the companies operating in this sector and the type of goods transported. Although these are general classifications, they are not entirely decisive. Courier is an extension of air express. Due to the removal of weight limits by air express and the ability to make scheduled flights, today, the differences between air freight are gradually decreasing (Long, 2012:175). Air cargo transportation companies serving in both mentioned divisions can organize their activities for only one type of service, considering customer expectations.

Within the corporate development process, there are two types of companies in air cargo transportation: those that do cargo as a side business and those that deal only with this business. These are also divided into integrated airline carriers, scheduled airline carriers, and non-scheduled carriers, in which charter planes are used as specialized cargo carriers (Murphy and Knemeyer, 2016:269). The status of air transportation changed in the 1980s when a young entrepreneur named Fred Smith believed that combining airline passenger and air cargo traffic was inefficient. Smith founded the company Federal Express in 1973, which provides a next-day delivery guarantee and only air cargo transportation. During its ten years of operation, it has achieved an incredibly significant revenue of one billion dollars. Federal Express bought Flying Tigers owner Tiger International Inc. in 1989 and merged the two airlines. Thus, Federal Express, the world's largest company that only transports air cargo, officially changed its name to FedEx in 1994. UPS, one of the important companies operating in air transport, has its origins in 1907, but it started to provide continuous air transport service since 1953 (U.S. Centennial of Flight Commission). On the other hand, Dalsey, Hillblom, and Lynn founded DHL, one of the world's largest air cargo transportation companies, as a door-to-door express delivery service in 1969 (Prezi). Besides, "Thomas Nationwide Transport (TNT)," a trucking and transport company in Australia, was founded in 1946 by Ken Thomas with a single truck. Wanting to expand towards Europe and the United

States, TNT moved its headquarters first to New Zealand and then to Brazil. The company changed its name to TNT Express Services U.K. & Ireland in 1978. In 1982, it got into the courier business by purchasing IPEC Holdings Co. Ltd., which operates in the USA and 26 countries (Hallsworth and Taylor, 1999:165). FedEx, UPS, TNT, and DHL, whose establishments are given above, are the world's four largest integrative companies operating in express air cargo transportation (Popescu, Keskinocak, and Mutawaly, 2010:216). On the other hand, when we consider the air cargo transportation as a whole, although many companies are operating in this field, according to the statistical report of IATA (2019), the companies that carry the most cargo are respectively FedEx, Emirates, Qatar Airways, UPS, Cathay Pacific Airways, Korean Air, Lufthansa, Cargolux, Air China, and China Southern Airlines. Today, the air cargo market has become a global market that concerns the whole world. All companies engaged in air cargo transportation, especially those mentioned above, are to expand their flight networks to increase their market shares and flight frequencies and reduce their costs by entering global markets.

5.3. The Development of Aircraft Used

Undoubtedly, the most critical vehicle used in air transportation is the aircraft. Aircraft produced in the historical development period affect the air transportation market differently. O'Connor (2000:65) divides the aircraft operating in the air cargo transportation market into three "dedicated aircraft," "convertible aircraft," and "combi aircraft." Dedicated aircraft are produced at a height where cargo can be quickly loaded, with large and wide doors. Convertible aircraft initially served as airliners one day and as cargo aircraft the other day with their seats removed. Aircraft used as an airliner was later converted to cargo aircraft due to their difficulties. On the other hand, Combi aircraft allow cargo to be carried both under the aircraft and in a section of the main fuselage reserved for passengers.

Aircraft used in air cargo transportation are also classified according to their body size and payload. Those with a capacity of fewer than 45 tons are categorized as "standard body," those with a capacity between 40 and 80 tons as "medium widebody," and those with a capacity of more than 80 tons as "large body." In this context, two major aircraft manufacturing companies, the American Boeing and the European Airbus draw attention. They produce the majority of airliners and cargo aircraft worldwide. However, some air cargo carriers also prefer Antonov, Ilyushin-type cargo aircraft. Standard Body aircraft consists of the Boeing 727, 737, 757, MD-80, DC-9, and Airbus A320 series. Medium Widebody aircraft are Boeing 767, DC-10, Airbus A300/A310, A330, and Ilyushin II-76TD. Large Body aircraft consist of Boeing 767, 777, MD-11, Antonov An-124, and Ilyushin II-96T aircraft (Boeing World Air Cargo Forecast Team, 2020:90). With the development of the aviation industry day by day, the production of wider-bodied aircraft and the expansion of the fleets of airline companies with these aircraft provide essential cargo capacities for international transportation.

5.4. Economic Development

Air cargo transportation, which is more expensive than other transportation systems, has emerged as an important market with the rapid changes in aircraft technology, large-capacity production, fuel-efficient, low-noise, emission-level aircraft, and the increase in global trade. To understand the economic development of air cargo transportation, it will be helpful to examine the amount of cargo carried, the fleets created to transport them, and the distribution of revenues.

In the 1930s and 1940s, it was thought that air transport, which initially started as postal transportation, would gradually become the most crucial source of income for airlines (Wensveen, 2007:325). However, air transport continued to develop with the increase in international trade. Companies directed their activities from postal transportation to passenger transportation and cargo transportation, escalating. O'Connor (2000:58) stated that from 1961 to 1971, the Freight Tonne Kilometers (FTK), carried only by American scheduled airlines, increased by five times, while the increase in passenger traffic was only three times.

With the liberalization of U.S. air cargo transportation in 1977, the sector rapidly changed. After that, Treaty on Open Skies between the USA and the Netherlands (1992), Canada-US (2006), EUUS (2007, amended in 2010), and ASEAN-China (2010) facilitated global airline alliances (International Transport Forum, 2019:16). In the civil aviation sector, together with the liberalization regulations in the USA, the European Single Aviation Market (1997) was implemented among the member states of the European Community, and the privatization of airline companies was supported. Instead, the increase in per capita income and the development of interregional trade in the Asia-Pacific region until the end of the 1990s expanded the air cargo market. By 1997, the U.S. Federal Aviation Administration (FAA) also removed all domestic cargo carriers' routes, pricing, and aircraft type restrictions. Thus, air cargo carriers could freely determine the prices, the markets they would serve, and their aircraft. In parallel with this, the development of air cargo transportation in the USA and the world increased with the introduction the just-in-time production (JIT) approach. On the other hand, while enabling the liberalization sector to turn into a more commercial structure, it also greatly affected the service quality, efficiency, and scope.

Today, the air cargo transportation market has become a global market that includes all regional markets and concerns worldwide. The development of world air cargo transportation traffic between 1989 and 2019 is seen in Figure 1. When examined, it is seen that the sector achieved significant annual growth of 5.8% in the period between1989-1999. However, during this period, the development experienced in this area slowed down, including in 1998, with the effect of the 1997 Asian Crisis. Between 1999 and 2009, the sector's growth rate slowed down. In this period, although there was some regression between the years 2000-2001, it is seen that the actual collapse was due to the effect of the 2008-2009 Global Financial Crisis. The average growth of 4.3% in the last ten-year period covering the years 2009-2019 shows that the effects of the crisis did not last long. Still, despite the adverse developments in the previous 30 years, it is seen that the air cargo traffic is in a stable development with an annual average growth of 4.1%.

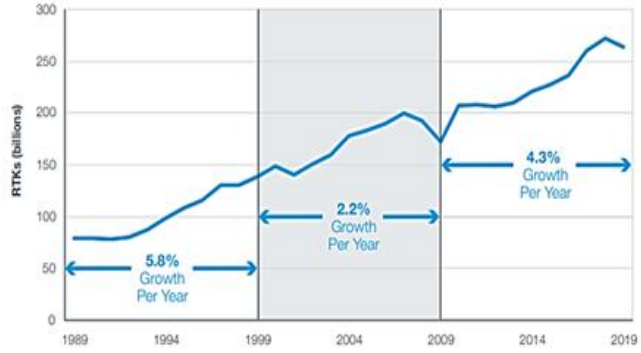

Figure 1. World Air Cargo Traffic (1989-2019)
Source: Boeing, 2020:21

There is a strong relationship between air cargo traffic, economic activity measured by GDP, and industrial production. It is one of the most critical determinants in developing the air cargo market. When Figure 2, where these relations are given together, is examined, the growth in global trade for the last 15 years until 2021 has significantly surpassed the growth in GDP, and the growth in the air cargo market has been more than the growth in global trade. This growth is due to the acceleration of globalization in the same period with liberalization, the development of service options, the awareness of the air cargo market by customers, economic advancements, and express transportation development.

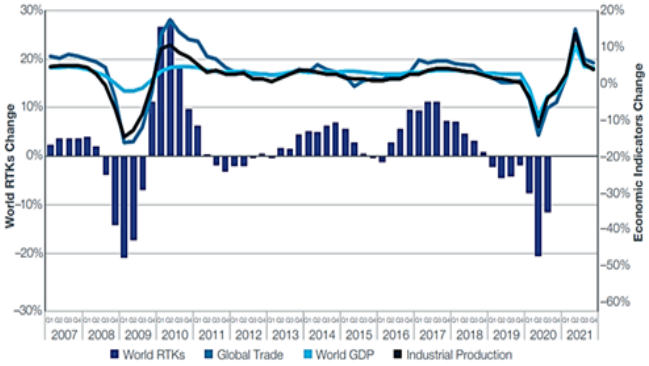

Figure 2. Relationship between World Economy, Global Trade, and Air Cargo Traffic
Source: Boeing, 2020:5

In this context, when the growth of air cargo traffic is analyzed with the help of Figure 3, it is seen that the annual average has grown by 4.3% between 2009 and 2019. For the reasons mentioned above, it is clear that it is a global and highly dynamic market that shows a growth trend, despite the decrease in traffic volume from time to time. Despite the short-term disruption caused by the pandemic at the end of the period, it is estimated that air cargo traffic, measured by Revenue Tonne-Kilometer (RTK), will grow by an average of 4.0% annually until 2039. Parallel to this, when air cargo transportation is taken into account directly in global trade, it is estimated that global trade will grow by an average of 4.7% annually from 2020 to 2025, according to the data of Boeing (2020:7,13,15,22). In this context, it is expected that the global air cargo transportation volume, which was 257 billion RTK in 2019, is more than double and will reach 568 billion RTK in 2039. The strong investor and customer confidence in the air cargo market strengthen these forecasts.

Figure 3. World Airline Cargo Traffic Growth Display (2009-2039)
Source: Boeing, 2020:8

If the prophecies come true, cargo aircraft that have carried more than 50% of the world's air cargo traffic since 2009 will continue to maintain this capacity by 2039. Excluding postal products from these cargoes, general cargo transportation, including all goods sent by air, constitutes the majority of the total world air cargo. It accounts for 81% of worldwide RTK and has an essential role in the global supply chain.

In parallel with the volume of air cargo traffic developments, the fleets have grown due to the airline companies' more investments in cargo, and new businesses have emerged in the sector market. As shown in Figure 4, while the number of freighter fleets carrying various sizes was 2,010 in 2019, it is estimated to grow by more than 60% to 3,260 in 2039.

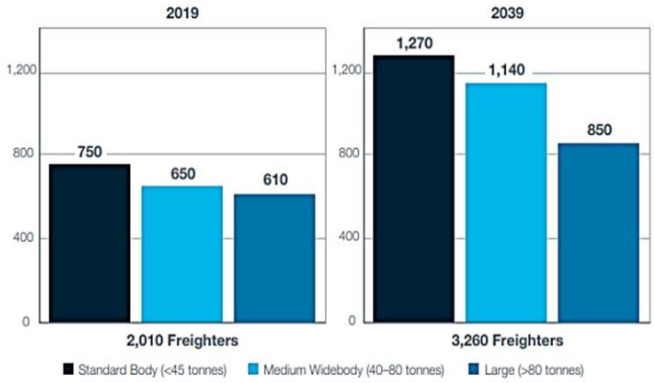

Figure 4. Freighter Fleet Totals
Source: Boeing, 2020:10

To compete in the air cargo transportation market, freighters, which are critically important, have been subjected to four distinctions by Boeing (2020:15) according to their mode of transportation. These are Express Carrier, Combination Carrier, All Cargo, and Passenger Belly Only. The distribution of the total revenues of the air cargo sector, which was 106 billion dollars for 2019, according to the modes of transportation, is shown in Figure 5. 42% of this revenue was obtained from Express Carrier, 36% from Combination Carrier, 11% from transportation with All Cargo aircraft and 11% from transportation as Passenger Belly Only. However, it is seen that airline companies that have Airlines Operating Freighters in their fleets have approximately 90% of the total revenue in the sector.

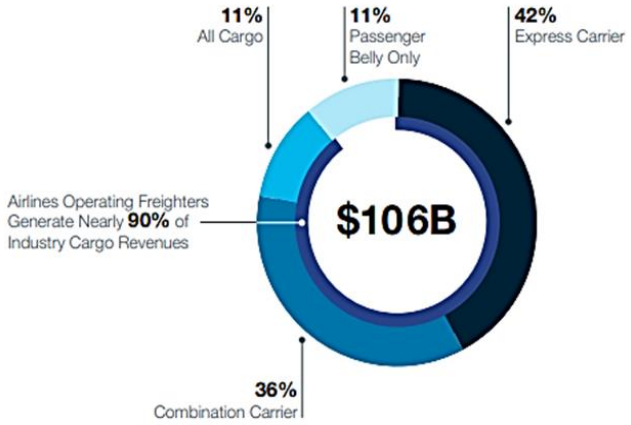

Figure 5. Air Cargo Freight Revenues (2019)
Source: Boeing, 2020:19

All in all, air cargo transportation has an important place in global trade. Air cargo meets approximately 1% of world trade only with the cargo volume but 35% of the world trade with its 6 trillion USD cargo value (IATA). This shows the necessity of preferring air cargo transportation for fast and safe transportation of valuable cargo. Indeed, competitiveness in the global economy depends on speed, trust, and the ability to offer high-quality products worldwide at affordable prices. In addition, air cargo transportation is a sector that facilitates trade, creates employment, and contributes to global economic development.

6. Airports

One of the critical factors for the realization of air cargo transportation is airports as well as aircraft. According to the data published by Airports Council International (ACI), 20 airports with the heaviest cargo handling capacity globally are shown in Table 2. Accordingly, Asia and America mainly have the most enormous cargo volumes. According to 2019 data, 4.8 million tons of cargo were handled at Hong Kong Airport, ranking first. Cargo airports, which provide significant advantages to compete in global trade, have strategic significance. Three different strategies are applied in the design of cargo airports in the world, depending on their characteristics and the city-region they are located in (Köprülü, 2019:26):

The first is the organization of airports in mega aviation cities as global cargo transfer parks. International airports such as Schiphol, Frankfurt, Charles de Gaulle, and Incheon, which are trying to become the leading logistics centers in the global economy, are examples of this trend. Of these, Incheon and Frankfurt are among the 20 airports with the heaviest cargo handling capacity in the world. They have cargo handling volumes of approximately 2.8 million tons and 2.1 million tons, respectively.

The second strategy implemented is to become a global logistics center through a strong logistics company. An example is the relationship between FedEx's logistics company and Memphis Airport. Memphis Airport has become a worldwide hub with the launch of FedEx and the creation of new cargo facilities. Almost all (95%) of the total cargo transported from Memphis Airport, which has been at the top of the world's air cargo transportation rankings for many years, is handled by FedEx. For 2019, Memphis Airport ranks second with a handling capacity of 4.3 million tons.

Another strategy is the regional planning approach in cities and airports where global centers cannot be established. Cargo business volumes are also low due to the lack of or limited "re-export" activities. With this practice, cargo operations at regional airports are expanded, services are diversified, and different product segments tried to be created. Munich, Vienna, Brussels, East Midland, Lyon Saint Exupery, Nice, Helsinki, and Liege airports can be given as examples of such regional cargo airports. However, they are not among the 20 airports with the highest cargo handling volume in the world.

Table 2. Top 20 Airports in The World According to Cargo Traffic Ranking (2019)

Place	Airport	Total Cargo (metric tons)*
1	Hong Kong, HK (HKG)	4 809 485
2	Memphis TN, US (MEM)	4 322 740
3	Shanghai, CN (PVG)	3 634 230
4	Louisville KY, US (SDF)	2 790 109
5	Incheon, KR (ICN)	2 764 369
6	Anchorage AK, US (ANC)**	2 745 348
7	Dubai, AE (DXB)	2 514 918
8	Doha, QA (DOH)	2 215 804
9	Taipei, TW (TPE)	2 182 342
10	Tokyo, JP (NRT)	2 104 063
11	Paris, FR (CGD)	2 102 268
12	Miami FL, US (MIA)	2 092 472
13	Los Angeles CA, US (LAX)	2 091 622
14	Frankfurt, DE (FRA)	2 091 174
15	Singapore, SG (SIN)	2 056 700
16	Beijing, CN (PEK)	1 957 779
17	Guangzhou, CN (CAN)	1 922 132
18	Chicago IL, US (ORD)	1 758 119
19	London, GB (LHR)	1 672 874
20	Amsterdam, NL (AMS)	1 592 221

*Cargo: Loaded and unloaded freight and mail in metric tons
** Includes transit freight
Source: Airports Council International, 2020

7. Effects of Air Cargo Transportation on Global Competitiveness

Rapid developments in globalization and technology have increased urbanization rates in the recent past. Hence, as the value judgments and cultures began to change, the societies' similarities began to emerge. In this context, significant changes have occurred in the demands of individuals. As a result, it has become a question that products designed in any geographical region of the world and produced in a different geographical region are demanded from another geographical region. In this context, product diversity has increased, shelf life has shortened, and the value of manufactured goods has increased. This has affected the logistics sector, and the reputation of supply chain management has grown. In line with these developments, the importance of competition between countries has increased even more.

In recent years, increasing trade trends in the global economy, which are becoming increasingly dependent on each other day by day, and rapid technological developments have

increased the importance of logistics activities. Today, it is impossible to compete in the global arena only by producing. For this, the product's price in the market with the same quality and characteristics must be lower than its competitors. This will be possible by reducing the cost of logistics activities. However, the dispersed location of logistics activities increases the costs significantly. The supply chain needs to be set up correctly to reduce transportation costs. In this context, clustering practices of logistics activities in specific areas called logistics hubs are becoming increasingly common. Integrating various transport modes in these logistics centers directly contributes to global competitiveness.

Air cargo transportation, which has become one of the fastest-growing sectors in the logistics sector, has become one of the most crucial elements for expanding the national economy and facilitating trade and global competition. Moreover, air cargo transportation, which is integrated with logistics centers, contributes to the international competition of countries because it has the highest cargo volume among transportation modes. Indeed, as stated in the previous section, while air cargo transport carries an exceedingly small amount of world trade in terms of volume, it has more than one-third of its value.

As can be easily understood from the above statements, mostly goods with relatively low volume and weight but high value are transported in air cargo transportation. The increasing preference for air cargo transportation is based on reasons such as the increase in the variety of products subject to world trade, the acceleration of business processes, and the intensification of competition (Kotler, 1997). Time-sensitive products and luxury goods are frequently transported in air cargo transportation in this context. Furthermore, with the increase in total welfare, individuals have shifted their demands from more products to higher quality products and services. For this reason, the demand for air cargo transportation has increased in the transportation of exotic foods, cut flowers, and medicine (Wells, 1999:364). Goods transported by air cargo are different from those transported by other modes of transport. There are two main reasons for this. The first is that it is possible to deliver the goods on time by shipping the goods faster than other types of transport. The other is that goods are transported more safely than road and maritime transportation, and cargo losses are much less (Air Cargo Week, 2021). Fast and reliable deliveries are essential to increase competitiveness in global trade and prevent customer loss (Teng, 2020:1) because globalization has brought fast delivery of goods to the forefront for producers and consumers. In addition to speed, safe, secure, and frequent transportation services are essential for the manufacturer. In this context, air cargo transportation has safe handling methods to prevent personnel or third parties from interfering with the cargo, which allows this to be realized.

Air cargo transportation is the only alternative in the trade conducted with transoceanic distances and requires speed. In general, the market share of air cargo transportation, which is faster and more reliable than other types of transportation, in the logistics sector is increasing. For this reason, the demand for the sector is rising, and investments are growing in parallel. Thus, the sector's global competitiveness increases with the decrease in waiting times and the decrease in transportation costs due to the reduction in storage costs. Furthermore, with the spread of logistics hubs, the "door to door" delivery model implemented by integrated transportation companies such as FedEx, UPS, and DHL by providing multimodal connections has been another factor that directly contributes to global competition by reducing the number of handling.

Another prominent issue in the global competition regarding air cargo transportation is aircraft technologies. The significant increase in international commercial activities with globalization necessitates that the aircraft used in transportation must be efficient and economical, especially in terms of fuel, for competitiveness. However, transportation costs are increasing due to the increasing oil prices and environmental awareness. In addition, the conversion of expired airliners into cargo aircraft, which is mentioned in the development of aircraft section, creates a disadvantage due to low capacity and fuel efficiency and maintenance costs due to malfunctions that occur due to the age of the aircraft. Therefore, aircraft fleets should be modernized by purchasing new technology aircraft to eliminate these negativities and increase global competitiveness.

In addition, one of the crucial factors for reducing costs in air cargo transportation is the optimization of the payload. The optimization problem, which tries to maximize profitability by using different loading options and aiming to use the current payload at the highest rate, is called "Loading Problem in Air Cargo Transportation (LPACT)" (Küçük and Hava, 2022:185). To achieve this, the shape and dimensions of Unit Load Devices (ULD), standards determined by IATA, should be used following the cross-section of the aircraft fuselage. In addition, damage to ULDs is another crucial factor that increases costs. To keep these to a minimum, innovation studies are currently being carried out to produce ULDs that are lighter, more robust, and reduce transportation risks. With ULDs, the amount and duration of handling are kept at a minimum level, thus reducing both packaging costs and wastage and losses.

Restrictions in the world economy for various reasons, such as the latest Covid-19 pandemic, 9/11 attacks, or the Asian Economic Crisis experienced in previous years, have devastating effects on global trade. The restrictions brought by the legal regulations to overcome this situation cause tighten the security measures, especially in air cargo transportation. As a result, the speed factor, which is the most vital advantage of air cargo transportation, cannot be used effectively, and delays occur in transportation processes, thus affecting global competition negatively.

Airports are undoubtedly one of the factors that play a significant role in the competitiveness of air cargo transportation in the global arena. To carry out these activities, the infrastructure of the airports is as vital as the economic, industrial, and commercial structure of the region. However, these alone are not enough, and airports should be considered as logistics hubs for other transportation modes. This situation was revealed in Sit's (2004:150) research on air transport logistics centers, and it was stated that the hubs to be created should be logistics and production centers that are time-sensitive, meeting the needs of e-commerce and new information systems, rather than just a terminal for the air transportation. Furthermore, he stated that these air cargo-based logistics hubs would potentially become a center that can accelerate development by bringing together new technological developments such as trade, emergency transportation services, JIT philosophy, and products produced in many global regions.

Air cargo transportation, a logistics sub-sector and one of the strategically valuable sectors that directly contributes to global competitiveness, tend to develop rapidly. However, it is thought that although its potential has increased with the effect

of technological developments, it is not used enough. For this, investing in air cargo transportation is essential for countries that want to improve their global competitiveness. Investments in this context should be made at airports that allow multimodal transportation, and these should be logistics hubs. Thus, with the advantages of air cargo transportation, it is predicted that it will become a vital sector in global competition by making more remarkable breakthroughs in the upcoming years.

8. Results

Air cargo transportation began to attract humankind's attention after managing to fly in its current form only in 1970 with the introduction of Jumbo jets into our lives. In these years, rapid changes in aviation technology have allowed the development of large-capacity, fuel-efficient, more eco-sensitive aircraft. On the other hand, the companies that emerged with the liberalization of aviation activities enabled the sector to become more commercial. National and international institutions have established the legal framework for functioning increasingly institutionalized air transport. The legal regulations regarding the sector should be constantly updated following the global commercial dynamics.

Although air cargo transportation is newer than other transportation modes in terms of its historical development process, it has become a mode of transportation that has been increasingly preferred in recent years. Air cargo transportation, which is a dynamic sector in which goods with relatively low volume and weight but high value are transported, is increasingly preferred due to its speed and safety advantages, especially with the intensification of global competition in parallel with the increase in the diversity of products in world trade. Although air cargo transportation is the type of transportation with the highest unit transportation costs, the necessity of speed brought by global competition and the difficulties encountered in transportation routes due to geographical locations can be counted among the most important reasons for developing this mode of transportation.

On the other hand, due to the globalization of the world economy, the increase in international trade volume and fast delivery expectations cause products with a short shelf life to prefer air cargo transportation over long distances. Thus, time and place benefit is provided in meeting the customers' needs. Air cargo transportation, which plays a crucial role in international trade, is developing rapidly due to increased interaction between countries. For this reason, it should be ensured that the tendency towards air cargo transportation should be increased by ensuring the continuity of the measures to meet the consumer needs at the right place and time.

One of the ways to increase global competitiveness in air cargo transportation is to modernize the aircraft fleet with fuel-efficient state-of-the-art aircraft. Thus, it will be possible to reduce fuel and maintenance costs, and the costs per unit load will also be reduced by using a more expansive capacity. In this context, optimization of the payload is also an essential factor. For this reason, packaging costs, number, and duration of handling should be reduced by using ULDs suitable for the cross-section of the aircraft fuselage.

Air cargo transportation, which has become one of the fastest-growing sectors in the logistics sector, contributes significantly to the global competition of countries due to having the highest cargo volume among transportation modes. However, the increasing potential of the air cargo transportation sector, which has a strategic importance that directly contributes to global competitiveness, is not used sufficiently with the effect of technological developments. Therefore, investment should be made in air cargo transportation. Furthermore, in hubs where logistics activities are clustered, investments should be made, and integration with other transportation modes should be ensured. In addition, transforming airports into logistics hubs equipped with the latest technological developments for different transportation modes should also be considered within this scope. Thus, with the advantages of air cargo transportation, it is predicted that it will become a vital sector in global competition by making more remarkable breakthroughs in the upcoming years.

Ethical approval

Not applicable.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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