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The International Air Cargo Industry

A Modal Analysis

Edited by
James Nolan and James Peoples

THE INTERNATIONAL AIR CARGO INDUSTRY

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ADVANCES IN AIRLINE ECONOMICS VOLUME 9

THE INTERNATIONAL AIR CARGO INDUSTRY: A MODAL ANALYSIS

EDITED BY

JAMES NOLAN
University of Saskatchewan, Canada

And

JAMES PEOPLES
University of Wisconsin-Milwaukee, USA

United Kingdom – North America – Japan
India – Malaysia – China

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ABOUT THE AUTHORS

Adedotun Joseph Adenigbo has a PhD in Transport Management with research interest in Logistics and Transport. His PhD thesis focussed on air cargo logistics in Nigeria and Ghana. Currently, Adedotun is a Postdoctoral Research Fellow at the Department of Transport and Supply Chain Management, University of Johannesburg, South Africa. He is also a Senior Lecturer at the Department of Logistics and Transport Technology, Federal University of Technology, Akure, Nigeria. Adedotun has articles published in both local and international journals and has contributed chapters to books such as *Contemporary Issues in Transport Development in Nigeria* and *Promoting Universal Access in Public Transport in Nigeria*.

Dermot P. Coates is a former Senior Economist-Statistician with the Central Bank of Ireland where his research interests included market-based funding, household wealth, and inflation. Dr Coates is also Adjunct Faculty at the National University of Ireland, Maynooth, where he also serves as a member of the Advisory Board of the Department of Economics.

Wouter Dewulf graduated a Master in Applied Economics (1992) and Master in Business Engineering (1993) at the University of Antwerp. After studies in Maitrise d'Administration et Gestion (IAG) at Université Catholique de Louvain, he worked at British Airways in London, Sabena Technics in Belgium and Van Gansewinkel in Belgium, France, and Luxemburg. As an "early midlife crisis," and after an inspirational meeting with Prof Van de Voorde, he started a PhD in 2007. He graduated in 2014 as a doctor in Applied Economics at the University of Antwerp. He is a Professor at the University of Antwerp and C-MAT (Belgium) and is the Academic Director of C-MAT. His main research areas are in the fields of air cargo, air transport strategy, and cross-border E-commerce. He is a Visiting Professor at the University of Hasselt (Belgium), University of Chongqing (China), and Trisakti Institute of Transportation and Logistics (Jakarta, Indonesia).

Euan Hague is Professor of Public Service and Director of DePaul's Urban Collaborative. A cultural and urban geographer, Dr. Hague is the coauthor of *Regional and Local Economic Development* (Palgrave, 2011) and coeditor of *Neoliberal Chicago* (University of Illinois, 2017). He received the Barbara A. Holland Scholar-Administrator Award from the Coalition of Urban and Metropolitan Universities in 2019.

Milan Janić is the Research Professor at the University of Belgrade, Belgrade, Serbia. Dr Janić is the author of many scientific and professional papers and books. Some recently published books are: *Transportation Engineering: Theory, Practice and Modelling* (Coauthor, 2nd ed), S*ystem Analysis and Modelling in Air Transport: Demand, Capacity, Quality of Services, Economics, and Sustainability*, *Landside Accessibility of Airports: Analysis, Modelling, Planning, and Design*, *Transport Systems: Modeling, Planning, and Evaluation*, *Advanced Transport Systems: Analysis, Modelling, and Evaluation of Performances*, *Greening Airports: Advanced Technology and Operations*, *Airport Analysis, Planning and Design: Demand, Capacity and Congestion*, and *The Sustainability of Air Transportation: A Quantitative Analysis and Assessment*.

Conor Kelly currently works as a Marcoprudential Policy Specialist for the Central Bank of Ireland and received his MSc in Quantitative Finance from SOAS. Conor works in the area of financial stability and capital, with a focus on macroprudential tools such as systemic risk buffers and countercyclical capital buffers. He also has research interests in public economics, labor, and housing, among others.

Zoe Laulederkind is a Graduate Research and Teaching Assistant at the University of Wisconsin-Milwaukee. Her research activities include funded research examining the influence of the repeal of prevailing wage in Wisconsin on the participation of out-of-state construction companies. She is also the coauthor of the chapter entitled *Allocative Efficiency in the US Air Cargo Industry*.

Tao Li is an Associate Professor at the Law School of Hebei University of Economics and Business, China. His research focuses on international economic law and international aviation management. He holds a PhD from the Law School of Shandong Province. He had been a lawyer specialized in trade remedies.

James Nolan is a Professor in the Department of Agricultural and Resource Economics at the University of Saskatchewan. He has published extensively on issues in transportation and agricultural economics, focusing mostly on modern freight transportation and the structure of these markets. A previous President of the *Transportation Research Forum*, Dr Nolan is also a former Coeditor of the *Canadian Journal of Agricultural Economics* and currently serves as Editor of the *Journal of the Transportation Research Forum*.

James Peoples is Professor of Economics at the University of Wisconsin-Milwaukee. His research interest includes analysis of production efficiency for different modes of freight transportation, as well as analysis of labor market activity in transportation industries. He has served as President of the Transportation and Public Utilities Group. He is also the Series Editor of *Advances in Airline Economics,* Coeditor of *Elements of Transportation Economics,* and Editorial Board Member of the journal *Transport Policy*.

Darren J. Prokop is a Professor of Logistics at the University of Alaska Anchorage, USA. He specializes in transportation economics and its effects on international trade and transportation security. Dr Prokop is an active consultant to both government and business. Prominent transport carriers, shippers, and policy-makers have relied on his modelling of complex problems in order to develop workable solutions to meet their needs. An expert on cabotage regulations, his opinions in this area are actively sought by international shippers and carriers. He has published seminal research in the leading academic journals with topics ranging from the microfoundations of logistics; air cargo logistics; and supply chain security modelling. Dr Prokop has contributed chapters to many books in his field. His own books include: *The Business of Transportation*, *Concepts of Transportation Economics, Global Supply Chain Security and Management*, and *Transportation Operations Management*.

Joseph P. Schwieterman is Professor of Public Service and Director of the Chaddick Institute at DePaul University, as well as President of the Transportation Research Forum. Schwieterman is a nationally known authority on transportation and urban economics. He is author of the book *Air Cargo and the Opening of China* and editor-in-chief of *Issues in Aviation Law and Policy*, a DePaul journal.

Olayemi O. Simon-Oke holds a PhD in Economics with a concentration in industrial, business, and development economics. He is a Professor at the Department of Economics, Federal University of Technology, Akure, Nigeria. Apart from his numerous published articles, he also has edited books and several chapters in Economics, including *The Fundamentals of Economics*; *Theory of Cost*; *Nigeria Econometric Reform*; *Health Investment and Economic Growth in Nigeria*; *Basic Economics*; *Community Banking*; and *Rural Development*. Dr Simon-Oke has attended several academic conferences on Economics and Management discourse both at local and international levels.

Mustafa Egemen Taner completed his undergraduate and graduate studies at Pamukkale University. He received his PhD in Industrial Engineering from Yıldız Technical University in 2018 while he was working for Quality Management and Data Evaluation Application and Research Center at Pamukkale University. He has been carrying out many studies on logistics and supply chain management, seaport management, operations research, and quality management and continues his research. He has been working as an Assistant Professor in the Department of Industrial Engineering at Tarsus University since 2021.

Thomas Van Asch graduated as a doctor in Applied Economics at the Faculty of Economics of the University of Antwerp, Belgium. His main areas of research are in the fields of air cargo, e-commerce, and airport strategy development. Thomas' PhD dealt with the strategy of European airports regarding air cargo. Before obtaining his PhD, Thomas finished his Master of Applied Economics at the University of Antwerp and his Master of Air Transport at C-MAT.

Eddy Van de Voorde is a Full Professor at the University of Antwerp, Faculty of Business and Economics. His activities are situated in Maritime Economics, Port Economics, Air Transport, and Logistics. His research, particularly in modelling freight transport, has resulted in a long list of publications in leading academic journals. Moreover, he recently has coauthored various standard works in transport economics and models. In the past years, he fulfilled different functions in international scientific associations, such as being the vice-chair of the International Association of Maritime Economists (IAME), vice-chair of the scientific committee of the World Conference on Transport Research Society (WCTRS), and chair of the Benelux Interuniversity Group of Transport Economists (BIVEC). He is visiting professor at different foreign universities, such as Lisbon, Bari, London (City University), and MIT (Cambridge, USA). In 2011, he got a visiting professorship at the Sapienza University in Rome. In 2005, he was awarded in Genua a prestigious international prize, the Premio Internationale delle Communicazioni "Cristoforo Colombo," for his scientific research in Maritime Economics.

Chunyan Yu is Professor of Air Transport Management at Embry-Riddle Aeronautical University (ERAU), David B. O'Maley College of Business in Daytona Beach, Florida. Her expertise is in economics of transportation and logistics industries; performance measurement and benchmarking of transportation infrastructure; regulatory policy analysis; demand analysis and forecasting; measurement and analysis of productivity and efficiency; applied statistics and econometrics. Dr Yu has more than 20 years of experience in teaching, research, consulting in Canada, the United States, Asia, and Europe. She has published books and academic articles in international journals and coauthored a number of research reports for government agencies and commissions in Canada, Asia, and Europe. Since 2001, Dr Yu has been the Research Director for the Air Transport Research Society (ATRS)'s Global Airports Performance Benchmarking Task Force.

Li Zou is Professor of Marketing and Supply Chain Management in David B. O'Maley College of Business at Embry-Riddle Aeronautical University, Daytona Beach, Florida. Dr Zou earned a PhD in Logistics, Transportation, and Supply Chain Management from University of Maryland, College Park. Her research into the economics of airline alliances, multimarket competition, air cargo revenue management, fleet standardization, and market entry strategies has been published in leading academic journals. She currently teaches airline management, international business, and air cargo logistics management at Embry-Riddle Aeronautical University. Dr Zou has served as guest editor for special issues of the *Journal of Air Transport Management* and *Journal of Air Transport Studies*. She is an executive committee member of the Air Transport Research Society (ATRS).

INTRODUCTION AND OVERVIEW OF THE INTERNATIONAL AIR CARGO INDUSTRY: A MODAL ANALYSIS

James Nolan and James Peoples

ABSTRACT

The continued rise in e-commerce has contributed to recent growth of the air cargo industry. In addition, international demand for low volume-high value products as well as time-sensitive goods continues to enhance demand for air cargo services. This volume consists of 11 chapters exploring whether this transportation sector has positioned itself to successfully take advantage of the economic opportunities associated with changing global demand for goods and demand for timely transportation services. Areas of analysis cover costs and competitiveness, shipper services and air cargo demand, along with international competition and economic development. Employing various empirical techniques and theoretical perspectives, these chapters help the reader to understand the methods by which air cargo companies provide efficient and increasingly affordable services, and also how the use of these services enhances economic growth and development.

Keywords: Freight integrators; air cargo sector; international air cargo operations; air cargo cartelization; air cargo productivity; supply chains

1. INTRODUCTION

With the ubiquity of just-in-time delivery and e-commerce, fast and efficient freight delivery remains in high demand. Not long ago, the air cargo mode was employed mostly to move higher valued goods destined for the wealthiest consumers. But with freer international trade, combined with scale/scope economies

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in air transport characterized by newer cargo jets with greater fuel efficiency capable of carrying heavier loads, we are seeing some formerly "bulky" commodities such as motorized vehicles, machinery, and transport equipment now moved by air, a modal decision that would have been unthinkable a generation ago.[1] While the scope of air cargo transport has expanded to include shipments of increasing volumes of various commodities, the industry continues to generate most of its revenue transporting high value/low volume commodities such as pharmaceuticals and electronics. Indeed, the International Air Transport Association (IATA) reports the transport of these goods contributed to $6 billion worth of goods shipped by air, which accounts for 35% of global trade by value.[2] The growing importance of air cargo is further underscored by noting that the transport of pharmaceuticals, a major contributor to revenue growth in the industry, plays a significant role in healthcare delivery in part because air cargo operators provide significantly faster transport of these vital products relative to other modes.

Despite evidence of the growing importance of this sector, research about the operations of air cargo has received considerably less attention than the air passenger sector. For instance, the initial listing of articles on Google Scholar that appear when searching for studies on US airline deregulation only highlight research on the deregulation of air passenger operations, even though initial deregulation of air transport services also targeted air cargo.[3] Recent global health issues have underscored the significance of this sector, as air cargo services during the recent COVID-19 pandemic rose to one-third of all airline revenue (IATA Air Cargo Media Briefing, 2021), whereas overall air cargo demand increased by 9.4% from October 2019 to October 2021.[4] Part of the growing demand for air cargo services that has occurred during the COVID-19 pandemic is comprised not only of the increased demand from vaccine delivery, but also through rising demand for at-home delivery of many consumer products over local retail services. In contrast to this growing reliance on air cargo, most passenger focused airlines have been forced to operate with idled aircraft due to slumping passenger demand stemming from COVID-19 related health concerns and regulations. This brief overview about recent issues within the air cargo sector underscores the significance of nascent research examining the operations of the modern air cargo industry.

The International Air Cargo Industry: A Modal Analysis contributes to our understanding of air cargo operations by examining three broad operational areas: costs and competitiveness, shipper services and air cargo company demand, along with international competition and economic development. Costs and competitive analysis includes examination of subcontracting, transport service planning, investment in technology and supply chain performance, airport choice, and competitive strategies. Demand research includes analysis of factors influencing the demand for air cargo services as well as demand for aircraft used by air cargo carriers. Our coverage of international competition and economic development issues examines the cartelization of international air cargo operations, liberalization of foreign competition in the Chinese air cargo sector as well as estimates of economic growth attributable to air cargo operations in parts of Africa.

2. COSTS AND COMPETITIVENESS

The initial set of chapters employ various modeling and empirical techniques to examine the complexities of operating cost-effective operations in the air cargo transport sector. The first chapter authored by Mustafa Taner develops a novel approach for air cargo forwarders in deciding whether to consolidate – where one agent is responsible for several jobs – or to integrate operations, where consecutive activities are merged within a particular job.[5] At the heart of this decision is the incorporation of risk factors for subcontracting agents while maintaining a low-cost operation. Taner argues that another key challenge freight forwarders face is choosing an optimum blend of consolidation or integration of operations. Using a mixed integer linear programming formulation solved by an ant colony optimization (ACO) methodology, the author considers the volume and weight capacities the agents can transport as well as failure and delay risks associated with contracting responsibilities to agents. Results indicate potential cost-savings associated with the use of the proposed technique as compared to currently used methods. Taner also shows shipment planning costs increase when including the effects of risk assessment. Nonetheless, the author's suggested methods generate cost-savings relative to other methods even when including the costs of risk assessment.

Analysis of air cargo operations continues in Chapter 3, where Milan Janic develops a methodology to examine the performance of supply chains served by an air cargo network. Examination of the network used to supply and distribute goods to customers is critical to a well-functioning economy, whereas an inefficient supply chain can negatively influence prices, output, and employment. Understanding the performance of different components of a supply chain provides vital information about societal benefits associated with efficient supply chains. This chapter contributes to our understanding of the gains coming from an efficient supply chain by developing a methodology that considers indicators of technical/technological, operational, economic, and environmental performance. This methodology is used to examine both ground and air cargo performance of Federal Express – the largest integrated air cargo carrier in the US. Results show that total network profits and the net contribution to US GDP derived from their air cargo transport services are substantially greater than the costs associated with inventories and externalities. Janic's findings also suggest that maintaining relatively low inventory and externality costs for the provision of a high demand service have generated significant gains for Federal Express as well as the US economy.

Further analysis of the factors contributing to differences in the operational cost of air cargo carriers is presented in Chapter 4. Zoe Lauledeerkind and James Peoples examine determinants of productivity growth in the air cargo sector. Applying a specification from standard producer theory, the authors consider the effect of load factors, stage length, number of airports served, network size, and density. Their results show negative productivity growth prior to 2001, shifting markedly to positive growth following 2001. The authors note that this growth transition is fueled primarily by productivity trends for unexplained technology

but appears to correspond with cargo carriers reacting to 9/11 by working in tandem with the US government to improve air cargo tracking. In their data, they could not identify productivity growth attributable to movement characteristics (load factor, stage length) or changes in network size and density. The authors note that the latter does not suggest movement characteristics are not an important source of productivity growth. Rather with the industry using an operations model that promotes express delivery and constrains aircraft utilization, this limits productivity enhancing attributes of longer stage lengths and higher load factors. But they offer that this operational model is likely to continue to yield higher returns that more than offset the effects of the constraints. Indeed, this work buttresses the findings from the previous chapter highlighting significant profits associated with the related operations model used by the sector's largest company.

Cost reductions in the air cargo transport sector are not limited to gains from technological innovation and other cargo operational activities since cost advantages can also arise by exploiting the attributes of different types of airports. Joseph Schwieterman and Euan Hague explore this issue in Chapter 5 by comparing cost advantages of both dedicated cargo airport and freight/passenger airports. Their overview shows the limited historical role of cargo-focused hubs within the mainland US. The authors attribute this limitation, in part, to significant market volatility and changing spatial distribution of the market. In contrast, the authors observe that complementarities among passenger and cargo traffic have created strong incentives for US air cargo companies to mostly utilize mixed-purpose airports. Nonetheless, Schwieterman and Hague report that recently, freight integrators in the US have turned several cargo-focused hub airports into operational focal points. In addition, a relatively new entrant to this industry – Amazon Air – selected seven regional US airports that lacked extensive passenger operations as operational focal points. Amazon has emphasized the cost savings associated with using airports close to its ground sorting centers, which also happen to be located in areas with relatively low road congestion. Due to the success of Amazon Air, the authors stress that the role of the air cargo specialty airport in the US is likely to grow in the future.

The analysis of Schieterman and Hague notably focused on the attributes of dedicated air cargo airports located across the US mainland. But one important cargo heavy airport that is not located on the mainland is Anchorage International Airport (Ted Stevens Airport). The next chapter by Darren Prokop is a case study that highlights the cost advantages associated with using the Anchorage airport as an air cargo hub. Prokop notes that Anchorage International Airport continues to be one of the busiest air cargo airports in the world, due in large part the airport's ability to offer foreign cargo carriers a unique operational option known as air cargo transfer. Essentially, the airport offers interlining assistance for cargo carriers. This allows air cargo carriers to save from significant economies of scale attributable to network efficiencies. The opportunity to take advantage of the cost-savings associated with landing and refueling at this advantageously located airport is especially evident for flights through Asia. Prokop reports that upwards of 80% of inbound air cargo planes

flying from Asia land and refuel in Anchorage before flying to North American and many European destinations.

3. DEMAND

The second set of chapters in this volume examine demand for air cargo services as well as demand for the particular aircraft used by air cargo carriers. The initial chapter of this group assesses air cargo strategies to attract air cargo company business, from the perspective of the airport. The competitive advantage of Anchorage airport reported in the previous chapter as well as competitive challenges faced by other US cargo dedicated airports discussed in Chapter 7 highlights the importance for competing cargo hubs to develop strategies to enhance demand for international air cargo traffic. In this chapter, Thomas Asch, Wouter DeWulf, and Eddy Van de Voorde expand the analysis of demand for cargo airport services by investigating the competitiveness of European countries in attracting air cargo transport services. They develop what they call their Airport Cargo Strategy Canvas to help identify successful strategies European airports can employ to enhance demand from prospective air cargo carriers. Subsequently, the authors apply their methodology as part of a case study of Brussels Airport to uncover the strengths and weakness of the current set of competitive cargo market strategies used by this major EU airport.

Growing demand for air cargo transport services not only promotes competition through airports to attract air cargo companies, but such demand also facilitates enhanced carrier demand for cargo aircraft. Interestingly, since 2000, Ireland has been a key source for both the import and export of cargo as well as passenger aircraft. This observation gives rise to the following questions: what are the business/economic forces that give rise to a small, open economy's demand for aircraft assets on a large scale? Is demand from air carriers merely a reflection of the country's location or are there other key factors? What can be learned from examining the role of the air cargo industry in demand? Dermot Coates and Conor Kelly address these questions in Chapter 8 by examining the flow of imports and exports of cargo and passenger aircraft to, and through, Ireland using Eurostat's International Trade in Goods Statistics (ITGS) dataset. Their study confirms that significant demand for aircraft assets from Ireland is due in part because principal bases for both Airbus and Boeing are now located in Ireland. In addition to new assets, since 2000, there has been a marked increase in the relocation of lessor and/or aircraft assets to Ireland. This increasing flow of both exports and imports of modern aircraft has benefitted the Irish economy. The authors report that exports of major passenger/cargo jets as well as other aircraft increased from 0.02 to 4.9% of total Irish exports from 2004 to 2017.

Findings from the Coates and Kelly chapter reveal how demand for air cargo equipment has contributed to a growing Irish economy. The succeeding chapter coauthored by Chunyan Yu, and Li Zou extend the analysis of economic benefits stemming from the air cargo transport sector by revealing how demand for this service acts as an engine for economic growth via international trade. The

authors empirically test the hypothesis that the growth of foreign direct investment (FDI) and the concurrent development of the global value chain contributes to the growth of air transport trade, and subsequently the growth of air cargo demand. To incorporate FDI in their empirical analysis, the authors develop an investment distance variable that depicts investment ties between the US and its trading partners. Air transport connectivity for both airborne trade and air cargo traffic is included in the empirical analysis since connectivity enhances the efficiency of global value chains. Their findings indicate that stronger investment ties (a negative parameter estimate on the distance variable) are associated with higher levels of air trade and volumes of air cargo shipments. In addition, this study suggests better global and regional air connectivity helps increase air cargo traffic volume beyond the demand by a country's airborne trade alone.

4. INTERNATIONAL COMPETITION AND ECONOMIC DEVELOPMENT

Findings from the previous set of chapters examining demand for air cargo highlight the benefits of this sector as a contributor to economic growth. However, the economic gains associated with air freight operations are influenced by the level of competitiveness in the market and as the chapter by Chunyan and Li indicates, economic gains are also dependent on air cargo carriers access to global and regional markets. The set of chapters in the last section of this volume contribute to our understanding of air cargo operations and international economic growth and development by examining market behavior and economic regulations in this transportation sector.

The initial chapter for this set of research examines anticompetitive behavior and the issue of cartelization in the international air cargo sector. While not deemed overly newsworthy at the time, in fact a vast and international air cargo cartel began operating toward the end of 1999. Despite the existence of several industry level regulatory and advisory bodies, the cartel was only formally exposed in 2006 to EU antitrust authorities by a participating carrier. James Nolan and Zoe Laulederkind argue that despite the severity and breadth of the cartel, there remains a dearth of research examining whether industry performance trends at that time were consistent with cartel behavior in the sector. The authors contribute to our understanding of regulatory oversight issues within the air cargo industry by using carrier level data to identify whether any notable changes in air cargo carrier revenues occurred during the known era of the cartel. Using data from before and after the time of the cartel, they identify a total of four significant break points across their sample. Two of the identified breakpoints occurred during the cartel era, both well before the cartel was exposed. The two other identified breakpoints occurred during the global economic crisis of 2007–2009 and during major production slowdowns in China, the latter characterized by enactment of protectionist policies worldwide. This work provides much needed quantitative evidence about the impact of the air cargo cartel, and

also highlights the on-going lack of viable regulatory oversight in the international air cargo sector.

In contrast to competitive restrictions associated with cartelization, the succeeding chapter by Tao Li examines the economic implications of fifth freedom traffic rights in China. Fifth freedom with China allows air cargo carriers to haul revenue traffic between foreign countries and China. Li reveals that this liberalization policy helped the air cargo sector overcome domestic capacity deficiencies generated by growing international demand for Chinese products. Further, this chapter observes that greater air cargo activity will require more airport and landing capacity in China. Li shows that Chinese cities with favorable economic and geographic conditions have taken advantage of fifth freedom to promote economic development through the enhanced use of air cargo services. Despite these observable economic gains, Li reports that only a few cities in China that can do so have opened fifth freedom cargo routes. With this challenge in mind, Li offers strategies for remaining Chinese cities to take advantage of the opportunities this liberalization policy offers for growing air cargo traffic and trade.

The final chapter in this section by Adedotun Adenigbo and Olayemi Simon-Oke seeks to broaden our understanding about the use of air cargo services in support of economic growth. Their research focuses on the role expanded air cargo transport services could play in the diversification of the Nigerian economy. The authors start by outlining the overdependence of the Nigerian economy on crude oil production, a focus that they argue limits the potential for overall economic diversity and growth. With limited ground transportation infrastructure in that part of the world, next they discuss trade and transportation policies that would promote greater use of air cargo operations. This could be done in order to readily export a diversity of high-value, low-volume goods produced in Nigeria, as well as other specialized and valuable agricultural products. In support of this argument, they conduct macro level empirical analysis indicating both short and long-run cointegration between air cargo exports and Nigerian GDP. From these findings, they infer that a healthy air cargo sector and economic diversification are complementary to economic growth in Nigeria.

5. CONCLUDING REMARKS

The formal first use of the airplane to deliver cargo occurred on November 7, 1910. This was part of a competition between rail and airplane delivery over a 65-mile route from Dayton to Columbus, Ohio. In winning that first race, air cargo revealed its potential value to shippers as a source of relatively fast and effective delivery. Since that first flight, the air cargo transport sector has now become an integral part of many modern supply chains, providing both national and international service. The chapters in this book offer original research that examines both the challenges faced by the modern industry as well as the ongoing economic benefits stemming from the availability of air cargo services.

Employing various empirical techniques and modeling perspectives, these chapters highlight the methods by which air cargo companies today provide effective and increasingly affordable services. Since air transportation is an important cornerstone of our modern world, other chapters also illustrate how access to and use of air cargo services enhances economic growth, trade and development.

While some chapters outline the benefits associated with air cargo services, they also reveal how uncompetitive behavior and limits both on access to international destinations and expansion of the sector can stifle economic growth. In light of these challenges, the authors provide policy prescriptions when necessary to facilitate access to competitive air cargo services, arguing that the latter can help diversify economies, promote regional job growth, and expand international trade. Several of the book contributions also develop novel techniques to further understand and enhance efficiency gains in the sector. However, cost-savings derived from using these techniques are necessarily constrained if anti-competitive market behavior prevails. Research in this volume also presents empirical approaches to identify evidence of such firm and industry behavior, which will hopefully be used by government authorities in the future to protect the interests of both domestic and international air cargo shippers. Overall, the book provides strong evidence that the development and expansion of an internationally competitive air cargo sector will likely continue to generate significant economic benefits across the globe.

NOTES

1. US air cargo companies shipped 116, 100, and 90 thousand tons of motorized vehicles, machinery, and transport equipment by 2017, the most current date when this data was made available for public use. *Source*: Freight Analysis Framework (FAF) (ornl.gov)
It should be noted that, as it grows the industry is not without its controversies or detractors, particularly from an environmental or competition policy perspective.
2. *Source*: air-cargo-brochure.pdf.
3. Federal legislation passed to deregulate air cargo transport was enacted in 1977, while deregulation of the air passenger transport sector was enacted in 1978.
4. *Source*: air-cargo-brochure.pdf.
5. As Taner notes freight forwarders are third parties who act as an intermediary between a shipper and various transportation services.

REFERENCE

IATA air Cargo Media briefing 11 May 2021 #ReadyToFly this session is recorded. Willie Walsh IATA's Director General Nick Careen IATA's SVP airport, passenger, Cargo & Security Brian Pearce IATA's Chief economist Cargo Leadership Team 11 May 2021; Cargo Media Day lite (iata.org).