The Economic Impacts of Covid-19 On The U.S. Airline Industry

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Abstract

Covid-19 has brought huge disaster and loss to the world. During the outbreak, the U.S. airline industry has been hit hard. It suffered loss of profits and substantial layoffs caused by the reduction of customers and travel restrictions. This paper usestime series econometric models and datasets from the Bureau of Transportation Statistics to study how Covid-19 impacts the profits and total employees in the U.S. airline industry.

This paper has found that the U.S. passenger airlines and cargo airlines have experienced different impacts on total employees and profits during the Covid-19 outbreak. Generally, due to the decrease of passengers during the epidemic period and the control of Covid-19 by the U.S. government, the total employees and profits of passenger airlines decreased significantly. In contrast, due to the increase in the transportation of anti-epidemic materials during the epidemic period, the total employees and profits of U.S. cargo airlines have increased significantly compared with non-epidemic periods.

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Attestation of Authorship

I hereby declare that this submission is my original work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

Signature:

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Chapter 1: Introduction

Airline industry as one of the major industry in the U.S. it contributes 5.2% of GDP in 2020. It creates four million jobs, with $850 billion in economic activity (Federal Aviation Administration. 2020). According to International Trade Administration. (2020), in the forth quarter of 2019 which Covid-19 has not yet affected the U.S., the total air transport exports in the U.S. is $17079 millions. However, this figure drops to $5203 millions in the second quarter of 2020 when the airline industry affected by Covid-19. The outbreak also impacts the air transport imports, the total air transport imports in the forth quarter of 2019 is $17718 millions, and it drops to $4859 millions in the second quarter of 2020. Passenger air transport is the most affected by the epidemic. Due to the control of Covid-19 by the U.S. government, the exports and imports of the passenger air transport decreased significantly from the fourth quarter of 2019 to the second quarter of 2020. However, the exports and imports of the cargo air transport have not changed much. Due to the increasing demand of anti-epidemic materials, the imports has a small increase in this period of time.

This paper uses the time series econometric models to study the changes in profit and total employees of the U.S. passenger and cargo airline during the Covid-19 outbreak.The reason this paper uses ARMA model to study this topic is because, this model is a tool for time series prediction, which is suitable for this study. ARMA model is a very simple model, which only needs endogenous variables, and no other exogenous variables are required. However, this this model has limitations. It requires time series data to be stable, and it can only capture the linear relationship, but it can not capture the nonlinear relationship.This paper uses ATMA model to predicts the results of the profit and total employees in two types of airlines if Covid-19 did not exist. The comparison between the actual and predicted numbers gives us the economic impacts of Covid-19 on the U.S. airline industry. This paper finds that the two types of airlines see different changes in their total employees and profits during the Covid-19 outbreak. Generally speaking, due to the coordinated epidemic control from the government and the reduction of passengers during Covid-19, the total employees and profit in the U.S. passenger airlines have a huge decrease compared to pre-Covid-19 period. In contrast, the total employees and profit of the U.S. cargo

airlines are much better than the passenger airline due to the increase of goods orders and the transportation of epidemic prevention materials during the Covid-19 outbreak. This paper also studies the total employees and profits of the top four passenger airlines individually and the top four cargo airlines. It has found that even the top four passenger airlines are struggling during the epidemic period. The total employees and profits between the top four cargo airlines are different, and the cargo airlines that actively transport epidemic prevention materials have better profits and more employees during Covid-19.

Covid-19 is a highly contagious disease caused by the coronavirus, a newly discovered virus (WHO, 2021). It appears to be easily spread and can be strongly infectious, through saliva and nasal discharge from infected people's coughs and sneezes. By the end of March 2020, the Covid-19 virus has been spread to more than 160 countries and regions all over the world. According to the World Health Organization, eighty percent of the peopleinfected with Covid-19 will experience mild or moderate levels of respiratory illness and will recover even with no special treatment; however, anyonecan be affected with Covid-19 and become seriously ill or die (WHO, 2021).

The U.S. airline industry has been through several crises before, such as the 9/11 terrorist attacks and SARS. Therefore, the econometric tools for analysis the effects of these crises are not new. There are several studies that use time series models to study the economic impact of all these big crises in the U.S. airline industry. Even though these crises did not hit the airline industry as much as Covid-19, still they made a serious impact, including lower employment and reduced profits. The 9/11 terrorist attacks dragged the airline industry into a devastating financial crisis, causing a 20% drop in air travel (Blunk et al. 2006). The reduced airline capacity led to the loss of more than 62,000 jobs in the airline industry, 11% of total U.S. industry employment at that time (Sehl, 2020). The outbreak of SARS also hit the U.S. airline industry hard. According to the Airline Industry Information (2003), air traffic from the U.S. to the Pacific region declined because of the SARS outbreak, falling by 35.7% in April 2003, compared to the previous year.

This paper focuses on two variables of interest: the profit and the total employees

of the U.S. airline industry.The policies that the U.S. government use to control Covid-19 have a strong impact on these two variables.Lockdowns were implemented in many cities to prevent the spread of the disease, and airports emptied as a result of reduced flights and travelers. A recentstudy about the impact of Covid-19 on the airline industry shows that both the number of flights and airline fares has been significantly reduced (Dube, Nhamo, & Chikodzi, 2021); the number of U.S. flight reduced about 50% comparing to the last year (Rimmer, 2020). The reduced number of travelers and flights led to financial loss for airlines. The four major airlines in the U.S. reported operating losses of $33.1 billion, a decrease of declined $50 billion compared to the last year (County of Huron, 2021). The recession in the airline industry certainly affected employment; a study predicted that the total airline employment would decrease by 7%-13% (Sobieralski, 2020).

The remainder of this paper consists of four Chapters: Chapter 2 is literature review which provides the basic research on this paper. Chapter 3 is Datawhich presents shows the data sources and econometric model used in this paper. Chapter 4 shows the predicted data, the actual data, and the comparison between them. Chapter 5 is the conclusion.

Chapter 2: Literature review

Interactions between pandemics and economic dynamics

Existing research in the literature has studied the interactions between pandemics and economic dynamics in different perspectives, which provides a basic theoretic framework for this research. Among them, Eichenbaum et al. (2020) develop a theoretic model which focuses on the containment policies and their impacts on economic situations. The authors suggest that containment policies of pandemics will reduce consumption and work, which is likely to cause a subsequent recession. There are high transmission risks of pandemics, which will cause many deaths. In this context, the market tends to be ineffective in controlling the spread of pandemics, which requires the governments and non-governmental organizations to initiate containment policies. The containment policies are aimed at reducing the number of deaths caused by a pandemic, with social distancing, restriction policies, and isolation treatment. However, consumer expenditure will also be negatively impacted, along with reduced job opportunities in the workplace. After the containment policies are implemented, it is likely the economy will be negatively impacted, leading to a subsequent economic recession. In this way, Eichenbaum et al. (2020) provide a theoretical model which explains the economic dynamics during pandemics. Based on this model, it suggests that with the spread of Covid-19, the contaminant policies reduce consumption and work, along with an economic downturn, which is the business context of the U.S. airline industry during the pandemic.

There have been a variety of pandemics in history that negatively impacted the economy, which provides insights for the economic dynamics during the Covid-19 pandemic. Barro et al. (2020) estimate the amount of economic decline attributed to a pandemic. In their research, the Spanish flu and First World War deaths were leveraged as proxies to estimate the impacts of a pandemic on the economy. Based on investigations on pandemics in history and their economic consequences, the decline of consumption will be about 6% on average. At the same time, the Gross Domestic Product (GDP) will also be reduced by about 8%. After the outbreak of Covid-19, there are ten million jobless people in the U.S. in March 2020. At the same time, it is also suggested that interest rates will be greatly increased by the pandemics. In their research, the economic situations caused by Covid-19 are compared to the financial

situation after the Great Recession. The authors suggest estimating the economic dynamics during the period of Covid-19 by investigating pandemics in the past. However, it remains unclear whether the proxies of Spanish flu and First World War deaths are reliable to predict the economic impacts of Covid-19 accurately.

Some other researchers focus on the economic dynamics during the Covid-19 pandemic specifically. The fact is that the pandemic of Covid-19 has significantly changed the world and how people work and live. The United Nations (UN) point out that the Novel Coronavirus has been a symbolic disruption in modern society, which requires people to adapt to a new order to survive and flourish after the pandemic. Enabling and facilitating social distance will remain important for people to protect themselves during the period. Based on their research, Atkeson (2020) argues that the social distancing policies could last for more than one year and a half. As long as the policies are implemented, it is likely the economy will be negatively impacted in the country, especially for the tourism and hospitality industry. This industry is characterised by direct interactions between customer and staff. As a result, it is likely that the businesses operating in the industry will suffer from reduced customer demand because of the social distancing policies. In this way, it provides a perspective to understand the U.S. airline industry during the pandemic of Covid-19. While the social distancing policies are estimated to last for approximately 18 months, it is probable the businesses in the sector will be negatively impacted during the period.

Mhalla (2020) studies the impacts of Covid-19 on the global economy, while focusing on the industries of oil and aviation. As Covid-19 was first found in China, it was also found in 74 countries and regions later on, the Chinese economy has been significantly impacted. By comparing the economic dynamics in the past, the author suggests that the scale of Covid-19 is larger than any epidemic in history because of high contagion risk and asymptomatic cases. Severe economic losses have been caused by Covid-19 on the global market. Specifically, the industries of oil and aviation have been severely impacted in the short run. Because of the current weight of China in world air traffic, the impacts of the Covid-19 will be much greater than the SARS epidemic in 2003.

Priyadarshini et al. (2020) further provides a detailed analysis of the economic

impacts of Covid-19 in different industries. The authors argue that the tourism and travel sector is most impacted by the outbreak of Covid-19, especially in North America, Europe, and China. Based on the overall effect of Covid-19 on the airline industry, the authors estimated the impacts of the pandemic on the travel and tourism industry in different areas. The study suggests that the profits of the travel and tourism industry are reduced by 9.41% in North America, along with a decline of 16.18% in Europe. The Asian travel and tourism industry has been most significantly impactedby Covid-19, with a decline of 27.08%. In the industry of restaurants and leisure, great damage has been caused. On 16 March 2020, the number of seated diners in restaurants across the world was reduced to 56%. Jobs in this sector are also greatly reduced with few staff working in the restaurants. In the entertainment industry, revenues are dramatically reduced as movie theaters are closed, movie releases are delayed, and screenings are canceled. In March 2020, profits of the global entertainment industry suffered a loss of more than $ 7 billion. In the travel industry, the travel restrictions have canceled trips for both business and leisure. In the week starting from 9 March 2020, the number of scheduled flights across the world was reduced by 10.1%. The number of flights in China dropped by 70.8%, while the flights in Italy was reduced by over 80%. Moreover, in the sports industry, many games and competitions were delayed or canceled after the outbreak of Covid-19, including the Olympics and Formula One races. If the Tokyo Olympic Games are going to be canceled, a loss of more than $602 million U.S. dollars will be suffered by Japan. In such ways, the authors have identified the significant impacts of Covid-19 on different industries across the world. Generally, many of the industries have suffered from great losses because of Covid-19, along with reduced employment rate at the same time.

Based on existing research on interactions between pandemic and economic dynamics, a theoretical context is established for this research. With the contaminant policies in responding to Covid-19, the global economy has been greatly impacted in the short term with reduced consumption and GDP. The economic dynamics like profits and employment rate are reduced by Covid-19 in different countries across a variety of industries. The next Chapter will discuss the impacts of the Covid-19 pandemic on the airline industry based on existing research in terms of employment rate and profit to provide a framework of this research.

Impacts of Covid-19 on the employment rate of airline industry

The employment rate in the U.S. airline industry has been negatively impacted by the Covid-19 since its outbreak. Sobieralski (2020) conducts research of airline employment in the U.S. with time-series analysis. The economic variables in the airline industry used in this research include revenue passenger miles (RPMs), available seat miles (ASMs), and departures for each airline. Using these variables, the vector autoregression (VAR) model is leveraged by the author to conduct the time-series analysis. By collecting the data from 1990 to 2020, the index of total U.S. air transportation employees is analysed to identify the impacts caused by significant uncertainty events, including Gulf Crisis, Asian Crisis, 9/11 Attacks, SARS, and Great Recessions.The author uses VAR model in this study because it is particularly useful for describing the dynamic behavior and prediction of economic and financial time series. It usually provides better prediction than univariate time series model and elaborate theory-based simultaneous equation model. Through the time-series analysis, the author suggests that air transportation employment will decline given production falls caused by these uncertainty shocks. Furthermore, the author examines the change of employment from an uncertainty shock specifically. In the research, Airlines are classified into three types of major, low-cost, and regional airlines. Comparing the different airline types, it is found out that major airlines are more exposed to the uncertain shock because of their inflexible business model. Following an uncertainty shock like the Covid-19 pandemic, employees working for major airlines will be faced with higher risks. Low-cost carriers and regional airlines would recover quickly after experiencing a decline because of lower wages of employees, as in the case of 9/11. By comparing the production decline caused by Covid-19 and other uncertainty shocks like 9/11, it is estimated that the baseline estimated job loss in U.S. air transportation is over 32,000 employees. A decline of the airline workforce is estimated to nearly 7%. Moreover, the author identifies six categories of airline employees, including cargo handling, aircraft handling, maintenance, passenger handling, aircrew, management, and others. Comparing the different categories of employees, those who are low skilled are more exposed to workforce reductions in the U.S. airline industry. To reduce costs during the economic reduction, it is likely that the airlines will reduce their employees through job cuts or outsourcing. Among them, the passenger handling employees in major airlines will suffer the hardest hit from the

pandemic because they are usually less presented by labour unions. Through the time series analysis, the author draws insights about impacts of Covid-19 on the employment rate of the U.S. airline industry with insights from uncertainty shocks from 1920 to 2020. However, the estimated job loss in air transportation based on the time series analysis needs to be examined with the newest numerical statistics in the industry.

After the outbreak of Covid-19, policy tool is implemented by the U.S. government which is aimed at supporting the airline industry to recover from Covid-19. Sobieralski and Hubbard (2020) investigate the impacts of the policy tools to support the U.S. airline industry to recover from Covid-19 on employment. After Covid-19, the U.S. government implemented positive policy tools to support the air transport system to recover from the pandemic. The authors point out the sustainability of the U.S. airline industry has been greatly threatened by the Covid-19. As a result, policy tools are useful to enhance sustainability of the industry and support local employment. The research analyses the impacts of jet fuel taxes on air traffic and employment in the U.S. with a difference-in-difference design, the authors compare data from major airlines in the U.S. the results suggest that the policy tool of jet fuel taxes have increased the air traffic. This policy tool is going to reduce the costs of airlines. An increase of over 0.2% is expected by the authors, which is unsustainable and will fade over the following 10-12 months. However, it is found that an insignificant change will be created by the price cut of jet fuel. Despite the increased air traffic, airlines in the U.S. are not effectively motivated to increase personnel. As a result, the authors suggest that the employment in the U.S. airline industry will not recover from the Covid-19 rapidly despite the implemented policy tool of the price cut of jet fuel.

Existing research has provided insights into the impacts of Covid-19 on the employment rate of the airline industry. Sobieralski (2020) estimates that the employment rate in the U.S. airline industry is reduced by 7% after the outbreak of Covid-19. The major airlines are most significantly impacted compared with the low-cost and regional airlines. Low-skilled workers in major airlines are faced with the greatest threats, who should be supported by policymakers in this context. Sobieralski and Hubbard (2020) also point out that the policy tool of jet fuel cut in the U.S. airline

industry is ineffective in supporting local employment in the industry. As a result, it will take longer for the employment rate in the U.S. airline industry to recover from Covid-19. In the following section, the impacts of Covid-19 on the profits of the airline industry will be discussed.

Impacts of Covid-19 on the profits of airline industry

The profits of the airline industry have been significantly impacted by Covid-19 in different countries. Liu (2020) studies the financial consequences of Covid-19 on the Chinese airline industry through using a Generalised Autoregressive Conditional Heteroskedasticity (GARCH) model. The study is based on data retrieved from the Chinese Airport Shipping Set (ASS). According to the research, Covid-19 proposed a high level of maximum potential loss of value to the airlines. Then, the value of loss was gradually reduced after the pandemic got under control in China. Based on the semi-annual financial reports, the revenues and net profits of major airlines have been greatly reduced. For instance, the profits of Air China were reduced by 31.03% than the previous year while the net profits were down 50.8%. By examining the stock index of major airlines in ASS, the author points out that the stock prices of major airlines in China, including Air China, Eastern Airlines, Southern Airlines and Spring Airlines, have been reduced since the outbreak of Covid-19. However, the author also figures out that the negative impacts on stock indexes of airlines gradually decreases. A reason for this is that the control of Covid-19 has been enhanced gradually, along with increased shipping. At the same time, the rise of RMB exchange rates also contributed to a decrease of impacts on profitability of airlines. In such ways, the author suggests that the profits of the Chinese airline industry have been greatly impacted by Covid-19. However, the negative impacts are decreasing since the pandemic has been under control with recovering demand in China.

Yadav (2020) studies the profits of the Indian airline industry after the outbreak of Covid-19. India is the ninth largest market of air traffic across the world. Over 85 international airlines are operating in the country. The Indian airline industry contributes to 2.4% of GDP of India's in 2019. The unexpected outbreak of Covid-19 greatly hit the Indian airlines. Most of the airlines in the county have no backup or recovery plans for the pandemic. In FY 2019, the domestic passengers in Indian airline industry reached 144 million. The author estimates the domestic traffic in India

will be reduced from about 140 million in FY 20 to around 85 million in FY 21. At the same time, international traffic will be reduced from around 70 million in FY 20 to about 40 million in FY 21. In sum, the whole number of passengers in the industry will be reduced by 50-60% because of Covid-19. With a sharp drop of traffic, the revenues of airlines are going to decrease greatly in India. Before international flights are allowed, some airlines are unable to pay revenue share to the Airport Authority of India (AAI). In such ways, this study suggests the significant decrease of profits in the Indian airline industry will last for a long period in the future.

Covid-19 has also reduced the profits of the airline industry with increased costs of grounding large numbers of aircraft. Adrinenne Budd and Ison (2020) point out that a lot of aircraft were grounded in the European airline industry in March 2020. During the pandemic, the number of parked aircraft reached 5,208 at the highest time. In the U.K., 837 aircraft were grounded in 20 airports. While a large number of aircraft are parked, challenges are created for the airlines, with increased costs. Actually, the aircraft are usually grounded in the airports that they do not usually serve. As a result, the airlines may need to pay for extra aircraft chocks and engine covers for the grounded aircraft. At the same time, in the sites where the aircraft are parked, there may be no sufficient ground service equipment, which will be charged for the airlines. Moreover, parking aircraft in bases different from the airports they are serving may lead to a problem of insufficient aircraft engineers to maintain them. In the long term, labour issues are caused when the flights are about to restart. After long layoffs, the flight and cabin crew need to be trained to retain their skills and resume normal duties in the industry. In the U.K., the government has suspended the air-side drive permits to 120 days. However, a large number of flight and cabin crew need to undertake new tests to acquire permits again. In such ways, the authors argue that the grounding aircraft because of Covid-10 has contributed to increased costs of airlines, which reduce their profits.

In addition to the airlines, the profits of airports are also negatively impacted by Covid-19 in the industry. Forsyth, Guiomard and Niemeier (2020) point out that the performance of airports has been dramatically reduced by Covid-19. Covid-19 has reduced demand for air transport services through reduced GDP. The authors argue that a 5% fall in GDP will cause a 5-10% fall in demand for air transport services. At

the same time, the cross-border travel restrictions contributed to the reduced passengers in air transport. Very few traffic has been witnessed since March 2020 in airlines across the world because of Covid-19. As a result, the demand collapse has greatly reduced the charges received by airports. Moreover, new requirements of health and safety have increased costs of airports. The authors studied the profits of airports of different types including regulated monopoly airports, public airports, light handed and non-regulated monopoly airports, and competitive airports. It is figured out by the research that profits of the airports have been significantly reduced by Covid-19 across the world. Financial problems are caused for airports by the fixed sunk costs, loan repayments, and little revenue. In responding to the demand collapse in the airline industry, price responses of airports are commonly seen after Covid-19. Furthermore, the authors argue that price increases during the pandemic are undesirable for different types of airports.

Existing research suggests that profits in airline industries have been greatly impacted after Covid-19 across different countries. Profits of the Chinese airline industry were greatly reduced, while the negative impacts are gradually decreasing. In India, the decrease of profits of the airline industry will last for a longer period with diminishing demand. During the pandemic, profitability of airlines is reduced by multiple factors including a large number of grounded aircraft. Moreover, profits of airports in the industry have been falling due to fixed sunk costs, loan repayments, and little revenue. In the next section, it will focus on the impacts of Covid-19 on the profits of the U.S. airline industry specifically.

Impacts of Covid-19 on the profits of U.S. airline industry

Currently, the studies focusing on the impacts of Covid-19 on the profits of the U.S. airline industry are sparse. Examining existing research, it could be found that some of them have provided evidence for the significant decrease of profits in the U.S. airline industry after the outbreak of Covid-19. Iannotta (2020) argues that it is urgent for U.S. airlines to win public trust amid the Covid-19 pandemic. Based on statistics provided by the United States Department of Transportation, it is estimated that the loss of after tax net profit in the U.S. airline industry reached $5.2 billion in the first quarter of 2020. Faced with reduced profits, the airlines are going through a tough time. By investigating health experts, the author points out that both the current

pandemic subsidiaries and the danger from Covid-19 will persist for a long period. Moreover, the spread of Covid-19 has damaged customer trust on airlines, which reduces their willingness for trips on air. As a result, it is critical for the airlines to earn the trust of customers through collaborating with a variety of stakeholders involved in the airline industry, including airports, governments, mass media, and health experts. Furthermore, the author points out a coming new reality in which innovations like supersonic flight, cleaner engines, bio-fuels, and electric propulsion will help airlines amid the Covid-19 pandemic through building public trust. In this way, this study points out that the profits of the U.S. airline industry have been greatly reduced by Covid-19 in the first quarter of 2020, which also threatened the trust of customers on airlines. However, the latest research on up-to-date trends of profits of the U.S. airline industry is lacking.

At the same time, the impacts of Covid-19 on profits of the U.S. airline industry vary by type of airlines. Nižetić (2020) compared the performance of different airlines during the pandemic in Europe and U.S.; by investigating the financial performance of airlines from January to April of 2020.The author argues that the air transport mobility in U.S. is gradually reduced after the outbreak of Covid-19, which reached a peak in April. However, the study finds out that the cargo traffic was not significantly impacted by the pandemic. The traffic of cargo is even increased sometimes because of raised supply of medical equipment. As a result, Covid-19 has most significantly reduced profits of the international passenger airlines in the industry. Comparatively, the domestic airlines are less impacted. At the same time, the cargo flights managed to create profits during the pandemic, which have been significant sources of revenues for the airlines. This study tries to compare the impacts of Covid-19 on different types of airlines in Europe and U.S. However, it failed to identify the differences in the U.S. airline context specifically.

In conclusion, there are not many existing studies that focus on the impacts of Covid-19 on the profits of the U.S. airline industry. Iannotta (2020) studies the decrease of public trust on airlines after Covid-19, while pointing out the loss of net profits after tax suffered by the industry in the first quarter of 2020. Nižetić (2020) points out the different impacts of Covid-19 on different types of airlines. However, latest research about impacts of Covid-19 on profits in the U.S. airline context is

lacking. In this sense, this paper is of importance in providing up-to-date insights of impacts of Covid-19 on the U.S. airline industry by far.

Chapter 3: Data

In this paper, I am using the Bureau of Transportation Statistics as my datasets to study the economic impacts of Covid-19 on the U.S. airline industry. The Bureau of Transportation Statistics is part of the U.S. Department of Transportation, which is responsible for compiling, analysing and providing accessible information on the U.S. transportation system. The reason I choose Bureau of Transportation Statistics as my datasets is because it contains comprehensive financial data about the U.S. airline industry. These include balance sheet statements, annual inventory of airframe and aircraft engines statements, airline employment statements, profit and loss statements, employee statistics by labor category statements, fuel costs and gallons of fuel consumed data and quarterly operating expense statements. Bureau of Transportation Statistics is a principal agency of the U.S. federal statistical system, which means the data is accurate and authoritative. The study of this financial data allows us to examine the economic situation of the U.S. airline industry and the changes that had occurred before and during the Covid-19 outbreak; so as to estimate the economic impacts of Covid-19 on the profit and the total employees of the U.S. airline industry.

The two main variables that Ifocus on this paper are the total employees and profit of the U.S. airline industry. These factors are significant to the airline industry since they can intuitively reflect the economic situation and the economic impacts of Covid-19 on the U.S. airline industry. Intuitively, if the airline industry is affected by the Covid-19 pandemic, profits of the collective airline companies are likely to fall, resulting in thelayoff of workers to reduce the burden of the operations. I obtained these two variables from Schedule P-1(a) and Schedule P-1.2 from year 2016 to year 2020 within the Bureau of Transportation Statistics datasets. Schedule P-1(a) provides monthly total employees data for all the U.S. airline companies. Original Schedule P-1(a) has a total 13 variables and I used 4 of the variables which were associated with my topic. These variables are Year, Month, Carrier Name and Total Employees. Total Employees includes monthly numbers of full time and part time employees, and Carrier Name includes all the U.S. airline companies. Schedule P-1.2 provides quarterly profit and loss statements for each U.S. airline company. However, Schedule P-1.2 only includes the airline companies with annual operating revenues of $20 million or more. Original Schedule P-1.2 has a total 53 variables and I used 4 of the variables which are associated with my topic, these variables are Year, Quarter,

Carrier Name and Operating Profit or Loss.

To construct my original dataset, I integrated Schedule P-1(a) and Schedule P-1.2 from 2016 to 2020 by using append in STATA. I separated the U.S. airlines into passenger airlines and cargo airlines, to understand how Covid-19 will bring different economic impacts to these two separate airlines sectors. In order to do so, I gathered information from all the airline companies in the U.S.airline industry and separated them into either passenger airline or cargo airline. After that, I generated a new column within my original dataset named “passenger”, then I categorized all the airline companies in the U.S. airline industry.All the passenger airline companies were shown as 1 in the “passenger” column, and all the cargo airline companies were shown as 0 in the “passenger” column. So far, I have completed the separation of the U.S. airlines.

The following chapters will not only study the U.S. passenger and cargo airline industry, but also study the U.S. top four passenger and cargo airlines individually. Therefore, the criteria for selecting the top four passenger and cargo airlines is by looking at profits. In 2020, the top four passenger and cargo airlines with highest profits will be selected as the top four airlines in this paper. According to Schedule P-1.2 from Bureau of Transportation Statistics, the top four passenger airlines with highest profits in the U.S. passenger airline industry are American Airlines, Delta Airlines, United Airlines and Southwest Airlines. The top four cargo airlines with highest profits in the U.S. cargo airline industry are Federal Express Corporation, United Parcel Service, Kalitta Air LLC and Jet Aviation Flight Services. In this paper, the way I classify the passenger and cargo airlines is by looking at their major business. Some of the top four passenger and cargo airlines have involved in passenger and cargo business. For example, American airlines offer passenger and cargo services, but the passenger business accounts for the majority of total business. Therefore, I classify American airlines as passenger airline.

Before doing further research, my conjecture was that theCovid-19 pandemic would pose some strong challenges to both airline sectors. Firstly, it was obvious that the U.S. government’s response to Covid-19 would bring innumerous restrictions to U.S. passenger airlines. As a result, I had conjectured that the total employees and

profit of the U.S. passenger airline would become very poor. Because of the restrictions imposed by the U.S. government, many international flights will not be able to enter the U.S., and a large number of flights even between states will be grounded. As a result, the U.S. passenger airline will lose a large number of passengers hence resulting in the loss of employees and reduced profits. Furthermore,it is my conjecture thatthe total employees and profit of the U.S. cargo airline may also be hit by the Covid-19 outbreak. Because of the Covid-19 outbreak and the U.S. government's resultant lockdown policy, I believed that the country would see a reduction in activity/productivity. The reduction inactivity/ productivity would then lead to the reduction of cargo transport demand. As result, the total employees and profit of the U.S. cargo airline will also be poor. However, the impacts of productivity reduction are not as intuitive as the impacts of loss of passengers. So, my belief was that the hit on the U.S. cargo airlines may not be as severe as the hit on U.S. passenger airlines.

The trend of the total employees in the U.S. passenger airline industry before and during the Covid-19 outbreak is quite different. Figure 1 shows from year 2016 to year 2019, total employees increased steadily. However, on 2nd of February 2020, The U.S. began to implement anti-epidemic entry regulations to the countries affected by Covid-19, where green card holders, immediate family members of U.S. citizens and non-U.S. citizens were refused entry to the U.S. Also, from 16thof March 2020, the U.S. President Donald John Trump announced a state of emergency resulting in a complete lockdown of many cities in the U.S. Since then, the U.S. airline industry has faced severe challenges. Therefore, Figure 1 shows that from the beginning of year 2020, the trend of total airline employees fell precipitously.

Covid-19 has a devastating impact on the profit of the U.S. passenger airlines with annual operating revenues of $20 million or more. Figure 2 showsfrom year 2016 to year 2019, although there were some fluctuations in the trend, these airline companies were still making profits. But after the U.S. government implemented anti-epidemic entry regulations and many cities in the U.S. began to lockdown, the profit of the U.S. passenger airline plummeted. As Figure 2 shows, from the beginning of year 2020, the trend of P&L fell sharply. This is mainly due to the large reduction in number of passengers caused by the entry restrictions and the lockdown policy in the

U.S. From the results of Figure 1 and Figure 2, I infer that due to the sharp decline in profit of U.S. passenger airlines, the U.S. airline companies made layoffs to limit their losses.

The epidemic has a positive impact on the total employees in the U.S. cargo airline industry. Figure 3 shows from year 2016 to year 2017, the trend of total employees was rising steadily, and from 2018 to 2019 this trend was rising sharply. Although due to the Covid-19 pandemic in early 2020, this trend has dropped a little bit, but around July 2020, the trend of total employees in the U.S. cargo airline rose even more rapidly than before.

Covid-19 has brought great benefits to the profit of the U.S cargo airline companies with annual operating revenues of $20 million or more. Figure 4 shows the profit of the U.S. cargo airlines has not been stable from2016 to 2019. But judging from the first quarter of year 2020, Covid-19 still had some influence on the U.S. cargo airlines.The profit in the first quarter of 2020 is at the lowest point in the past four years. However, after the first quarter of year 2020, the profit of the U.S. cargo airline started booming. The resultsofthe U.S. cargo airline seemed not to have been hurt by Covid-19. On the contrary, theCovid-19 pandemic had made the profits of U.S. cargo airlines even better. I believe the reason for that is because the Covid-19 outbreak makes people stay at home more therefore, people use the Internet to buy goods during the outbreak, which resulted in more cargo airline orders. So as the orders increased, the profitalso increased.

The results from Figure 1 and Figure 2 proved my conjecture.Due to the impacts of Covid-19, the total employees and profits of the U.S. passenger airlines did go down, the trend of total employees and profits both fell sharply. However,the trend of the total employees and the profit of the U.S. cargo airline both increased sharply, Covid-19 did not make the total employees and profits of the U.S. cargo airlines worse, instead it actually got better.This is something I didn't expect before I did my research.

Chapter 4: Estimation And Results

The ARMA model is a tool to predict what would happen to the U.S. airline industry if Covid-19 did not exist. It can provide the predicted values of total employees and profit in the U.S airline industry. The comparison between the predicted data and the actual data will be the economic impacts of Covid-19 on the U.S. airline industry.

The general ARMA equation is given by the following

$$X_t = c + \varepsilon_t + \sum_{i=1}^{p} \varphi_i X_{t-i} + \sum_{i=1}^{q} \theta_i \varepsilon_{t-1}$$

where X_t isthe time-series data of the variable of interest. $\sum_{i=1}^{p} \varphi_i X_{t-i}$ are the autoregressive terms and$\sum_{i=1}^{q} \theta_i \varepsilon_{t-1}$are the moving average terms;$\varphi_1,\ldots\varphi_p$&$\theta_1\ldots\theta_q$are the parameters of the model, c is a constant, ε_t is error term.

An autoregressive model describes the relationship between the current value and the historical values of the variable of interest. It uses the historical data of the variable itself to predict future data. The general AR equation is given by the following

$$X_t = c + \sum_{i=1}^{p} \varphi_i X_{t-i} + \varepsilon_t$$

where X_t is current value, c is a constant, p is the order, φ_i is auto-correlation coefficients and ε_t is an error term.

A moving-average model focuses on the accumulation of the error terms in AR. This model can effectively eliminate the random fluctuations in the prediction.The general MA equationis given by the following

$$X_t = \mu + \varepsilon_t + \sum_{i=1}^{q} \theta_i \varepsilon_{t-i}$$

where θ_i is the parameters,μ is the expectation of X_t and $\varepsilon_t \varepsilon_{t-i}$ are the error terms.

Order selection is a procedure to determine a suitable value for q. In the ARMA prediction model, q is the number of lags which forecast on the errors. Also, order selection is a procedure to determine a suitable value for p. Generally, a time-series variable has temporal correlation. For example, when the time interval is small

enough, if the speed of a car at some point in time is slow, the speed at the next point in time is often slow. This internal correlation enables us to predict the next few time points according to the observed values of the recent time points. AR(1) is "first order autoregressive process." which means the result variable of AR(1) in time t is only related to the time period t-1. AR(2) and AR(3) are the processes which would be related to the data 2 or 3 periods apart.

The Akaike information criterion (AIC) provides a means of order selection, to select the p and q in the ARMA model. The AIC is often used to measure the complexity of the statistical model and the goodness of fit. The AIC equation is: AIC=2k-2ln(L), where k is the number of the parameters and L is the likelihood function with the maximum value. All AIC values computed for order selection can be found in the Appendix. Appendixsummarizes all the AIC values for total employees in the U.S. passenger airline,total employees in the U.S. cargo airline,profit in the U.S. passenger airline and profit in the U.S. cargo airline. Table 1summarizesthe coefficients and the log likelihoods of the alternative ARMA models with the minimumAIC value.

The cutoff point for the actual data and the predicted data of the total employees is in February 2020, and the cutoff point of the profit is in the fourth quarter of 2019. The U.S. government started to implement anti-epidemic entry regulations to the countries which are affected by Covid-19 since 2ndof February 2020, and the airline industry in the U.S. has been challenged since then. Therefore, the data prediction of the total employees will span the period between February and September 2020. The reason to end the data prediction in September 2020 is because the last data I have from the Bureau of Transportation Statistics is in September 2020. My data prediction for the profit of the U.S. airline industry will span the period between the fourth quarter of 2019 and the third quarter of 2020. The fourth quarter of 2019 was the closest time period to the Covid-19 outbreak, and the last data I have is in the third quarter of 2020. The comparison between the actual data and the predicted data will give the economic impacts of Covid-19 on the U.S. airline industry.

Counterfactual analysis refers to the comparison between the results of

interventions with the results that would have been achieved if interventions were not implemented. In this paper, Covid-19 is the treatment. The actual data for the U.S. airline industry gives us the “treated” outcome, and the predicted data gives us the counterfactual “non-treated” outcome. The following paragraphs will elaborate the counterfactual analysis of the U.S. passenger and cargo airlines respectively.

The total employees in the U.S. passenger airline exhibits a large difference between the actual data and counterfactual predictions. In Figure 5, the blue line indicates the predicted trend, and the red line graphs the actual trend. Figure 5 showsthat the actual trend from February 2020 to September 2020 has sharply decreased. In contrast, the predicted trend from February 2020 to September 2020 is smooth and steady. Table 2 shows the actual data, predicted data and the percentage difference between these two from February 2020 to September 2020. The predicted data from February 2020 to March2020 have practically no difference compared with the actual data; the percentage differencein these two months is 0.25% and 0.19% respectively. However, there are some big percentage differences between the predicted data and the actual datafrom April 2020 to September 2020. Among them, the smallest appears in April 2020, with -7.23% percentage difference. The largest gap appears in September 2020, with -12.51% percentage difference. The results from Table 2prove that Covid-19 has negative economic impacts on the total employees of the U.S. passenger airline.Figure 15 provides the regression of total employees in the U.S. passenger airline. In this case, when arL1 increases by 1, total employee increases by 1, the p value is 0, which means it is statistically significant. When maL2 increase by 1, total employees increases by 0.65. The p value is 0, which means it is also statistically significant.

The counterfactual predictions of the profit in the U.S. passenger airline are much higher than the actual results. Figure 6 shows that from the fourth quarter of 2019 to the third quarter of 2020, the predicted trend has a small range of fluctuations. However, in reality, the profit trend of the passenger airline has a nearly straight decline from the fourth quarter of 2019 to the third quarter of 2020. The U.S. passenger airline is not only unprofitable, but also suffers huge losses. Table 3 shows more details of the data. In reality, the profit in the fourth quarter of 2019 is around $4203 thousand dollars, and the predicted profit is about $4573 thousand dollars.This

gives a percentage difference of -8.1%; the predicted data and the actual data for the fourth quarter of 2019 are still positive. However, from the first quarter of 2020 to the third quarter of 2020, there is a big difference between the actual data and the predicted data. The predicted profit for the first quarter of 2020 is around $3303 thousand dollars, but the actual profit for this period is around $-4534 thousand dollars, and the percentage difference between them is-237.28%. The percentage differences in the second and the third quarters of 2020 aremuch bigger that the first quarter of 2020. The predicted profit for the second quarter is around $6522 thousand dollars, the actual profit in this quarter is around $-16157 thousand dollars, and the percentage difference is -347.73%. In the third quarter, the predicted profit is around $6492 thousand dollars, the actual profit is around $-15847 thousand dollars with -344.12% percentage difference. Figures 7 and 5 clearly show that Covid-19 has huge negative economic impacts on the profit of the U.S. passenger airline.Figure 16 provides the regression of profits in the U.S. passenger airline. In this case, when arL1 increases by 1, profit increases by 0.81, the p value is 0. Therefore, it is statistically significant. When maL3 increases by 1, profits increases by 0.49. However, the p value in this case is 1.74 which is much higher than 0.05, so it is not statistically significant.

The total employees in the U.S. cargo airline have higher actual results than the predicted counterfactual.Figure 7 shows that the actual trend from February 2020 to September 2020 increased sharply. But the predicted trend from February 2020 to September 2020 is in a state of slow decline. Table 4shows more details about the data results. From February 2020 to September 2020, total employees in the U.S. cargo airline do not fluctuate significantly. The smallest percentage difference between the actual data and the predicted data appears in March 2020 which is -0.17%; the actual total employees in this month is around 260.1 thousands of employees, and the predicted total employees in this month is around 260.5 thousands of employees. The largest percentage difference appears in September 2020 which is 4.03%; the actual total employees in this month is around 270 thousands of employees, and the predicted total employees in this month is around 260 thousands of employees. Table 4 and Figure 7show that the predicted total employees in the U.S. cargo airline is not as good as the total employees in reality. Therefore, Covid-19 has positive economic impacts on the total employees of the U.S. cargo airline. Figure 17 shows the

regression oftotal employees in the U.S. cargo airline. When arL1 increases by 1, total employee increases by 0.99, the p value is 0, so it is statistically significant. When maL2 increases by 1, total employees increase by 0.22. But the p value in this case is 0.153, which means it is not statistically significant.

Figure 8 and Table 5 demonstrate that the Covid-19 outbreak is increasing the profit of the U.S. cargo airline. Figure 8 shows that the predicted trend and the actual trend were both increasing from the fourth quarter of 2019 to the second quarter of 2020. However, after the second quarter of 2020, the predicted trend went down, and the actual trend went up. Table 5shows more details of the data. The data of the fourth quarter of 2019 shows the predicted profit is larger than the profit in reality, and the percentage difference in this quarter is -15.54%. The predicted data for the first quarter of 2020 is very different from the actual data, and the percentage difference in this quarter is -61.98%; the predicted profit in the first quarter of 2020 is around $800 thousand dollars, the actual profit in this quarter is around $304 thousand dollars. However, from the second quarter of 2020, the actual data has become greater than the predicted data. The predicted profit in this quarter is around $913 thousand dollars, and the actual profit is around $924 thousand dollars. In the third quarter of 2020, the actual profit is larger than the predicted profit with 31.01% percentage difference. Figures 8 and 6 prove that Covid-19 has positive economic impacts on the profit of the U.S. cargo airline.Figure 18 provides the regression of profits in the U.S. cargo airline. This table shows when arL1 increases by 1, profits increases by 0.21, the p value in this case is 0.88. Therefore, it is not statistically significant. When maL3 decreases by 1, profits increases by 0.88. However, the p value in this case is 0.153, which means it is also not statistically significant.

Now we are switching our level of analysis from the industry aggregate to individual airlines. Delta Airlines stands out among in the top four U.S. passenger airlines, with a huge decrease in total employees during the Covid-19 outbreak. The Top four U.S. passenger airlines are Southwest Airlines, United Airlines, Delta Airlines and American Airlines. Figure 9 shows the predicted trends and the actual trends of these four airlines. The yellow, red, blue and green lines respectively indicate the actual trends. The pink, purple, black and teal lines respectively indicate the predicted trends.

Table 6 shows that the biggest percentage difference between the predicted data and the actual data of American Airlines from February 2020 to September 2020 is 1.55%, and the smallest percentage difference is -0.02%, which means that Covid-19 has no significant impact on the total employees of American Airlines. According to the results from Figure 9 and Table 6, the total employees of Southwest Airlines is also not significantly affected by Covid-19. As Table 6 shows that, from February 2020 to August 2020, the percentage difference between the predicted data and the actual data is no more than -1.56%. The largest difference of the Southwest Airlines appears in September 2020, the actual total employees in this month is around 59 thousands of employees, and the predicted total employees in this month is around 63 thousands of employees with -5.77% percentage difference. However, Covid-19 has a significant impact on United Airlines and Delta Airlines. Figure 9 shows the predicted trend of the United Airlines from February 2020 to September 2020 was upward sloping, but the actual trend from this time period was downward sloping. Table 6 shows the largest percentage difference of the United Airlines appears in September 2020 with -16.85%. The number oftotal employees of Delta Airlines is even worse compared to United Airlines. Figure 9 shows from February 2020 to September 2020, the predicted trend of Delta Airlines was stabled. However, the actual trend from this time period has sharply decreased, with a slight recovery from July 2020; but from September 2020, this trend continues to decline. As Table 6 shows since April 2020, the gap between the predicted data and the actual data began to have a significant difference; the largest percentage difference of the Delta Airlines appears in May 2020 with -43.40%. According to the 2020 annual report of Delta Airlines, the sharp decline in the total employees of Delta Airlines is due to a large number of layoffs in order to cut costs. In 2020, more than 40000 employees took unpaid leave. About 18000 employees have accepted buyouts or early retirement packages (DELTA AIR LINES, INC. 2020).

The sharp decline in the total employees in the top four U.S. passenger airlines indicates that Covid-19 has a negative impact on the industry. Due to the reduction of passengers and the government's control of the epidemic, these airlines need to lay off a large number of employees to reduce operating costs, so that they will not have further losses during the epidemic. The decline of employees in the U.S. passenger

airlines will lead to an increase in the unemployment rate in the U.S.

During the Covid-19 outbreak, the profits of the top four U.S. passenger airlines had dropped a lot. Figure 10 shows that the predicted trends for the top four U.S. passenger airlines were all increasing from the first quarter of 2020 to the third quarter of 2020. However, their actual trends had steep declines over this time period. Table 7 shows the loss of American Airlines is the smallest in the top four airlines during the Covid-19 outbreak, but the percentage differences between the predicted data and the actual data of this time period are still huge. The biggest percentage difference occurs in the third quarter of 2020, the predicted profit in this quarter is around $879thousand dollars, but the actual profit in this quarter is around -$4945 thousand dollars with -662.58% percentage difference. Delta Airlines and Southwest Airlines are also negatively affected by Covid-19. Table 7 shows Delta Airlines was strongly affected by the Covid-19 outbreak in the second quarter of 2020, the predicted profit in this quarter is around $1880 thousand dollars, but the actual profit is around $-3518 thousand dollars with -287.15% percentage difference.

The U.S. is the primary market of Delta Airlines. the federal government does not encourage travel and encourages social distancing and limits large-scale population aggregation. Also, because of the Covid-19 outbreak, a large number of business conventions, major sports events, concerts and other similar activities have been canceled, or held with limited or no audience. All these adjustments have reduced the demands for business and leisure air travel. However, all these demands are the biggest source of revenue of the Delta airlines, which leads to a substantial reduction of the passenger tickets.Delta Airlines has taken a variety of actions to reduce the impact of the epidemic on the business. For example, it has greatly reduced their flight capacity and blocked the middle seats of all the flights. Meanwhile, in order to protect the safety of their employees and customers, it has implemented additional cleaning measures for all the aircrafts and operating airports. These additional cleaning measures also increased their costs. Furthermore, because of the lack of confidence from the passenger in air travel under the epidemic, it faces a large number of ticket cancellations and refunds. These effects associated with the Covid-19 outbreak have a negative impact on air travel, which has had a significant negative impact on Delta Airline's revenue and financial position (DELTA AIR LINES, INC.

2020).

Southwest Airlines was hit hard by the epidemic in the fourth quarter of 2020, the predicted profit in this quarter is around $826 thousand dollars, but the actual profit is around $-2658 thousand dollars with -421.77% percentage difference. The reasons for the decline in profits of Southwest Airlines are similar to Delta Airlines: the negative impact of the epidemic on the U.S. tourism and hotel industry resulting in a substantial reduction in passenger ticket orders. Meanwhile, Southwest Airlines has actively reduced their flight capacity, and they also suspended dividends, share repurchases and decreased their capital spending (SOUTHWEST AIRLINES CO. 2020).

The sharp decline in the profits of the U.S. top four airlines further proves the impact from Covid-19 on the U.S. passenger airlines is huge. The U.S. passenger airlines are closely related to the whole U.S. economy. According to a report from Federal Aviation Administration, the U.S. airline industry contributes 5% of the U.S. GDP (Federal Aviation Administration. 2020). The profits of most passenger airlines were negative during the epidemic period.It shows that the number of passengers is greatly reduced, and the demand of consumers for travel also reduced, which further led to the decrease of consumption in the U.S.

Now we are switching our analysis from the passenger to cargo airlines. Jet Aviation Flight Services is the exception in the top four U.S. cargo airlines, since it was the only airline that had a significant reduction in the total employees during the Covid-19 outbreak.Figure 11 shows the predicted trends and the actual trendsof three of the top four U.S. cargo airlines (without Federal Express Corporation). The yellow, red, and blue lines respectively indicate the actual trendof these airlines. The pink, purple and black lines respectively indicate the predicted trendof these airlines. Figure 12 shows the predicted trend and the actual trendof the Federal Express Corporation. The green line indicates the actual trend and the red line indicates the predicted trend.

Figure 11 and Figure 12 show that the predicted trends of Kalitta Air LLC, United Parcel Service and Federal Express Corporation are not so different compared to their actual trends. The actual trends of these three airlines from August 2020 to

September 2020 are all greater than their predicted trends. According to Table 8, the percentage differences of these three cargo airlines from February 2020 to September 2020 are all no more than 8%. This proves that Covid-19 did not have a negative impact on these cargo airlines. However, Jet Aviation Flight Services is the worst performing cargo airline in the top four U.S. cargo airlines during the Covid-19 outbreak. Figure 11 shows that from February 2020 to September 2020, it is the only cargo airline that the predicted trend was higher than its the actual trend. Table 8 shows that from April 2020 to September 2020, the percentage difference between the predicted data and the actual data are all more than -15%. Jet Aviation Flight Services is different from most of the cargo airlines, as it is a subsidiary of General Dynamics, which is a company mainly engaged in design, manufacturing, and service for business jets. The decline in the total employees of Jet Aviation Flight Services is due to a general downturn in the defense industry, which has led to a reduction in production orders.Therefore, the company needs to cut costs by laying off employees(General Dynamics. 2020).

Generally, Covid-19 has a positive impact on the total employees of the U.S. cargo airlines. During the epidemic, the transportation demand and order volume of anti-epidemic materials increased significantly; cargo airlines need to hire more employees to complete the jobs, so the total employees has increased significantly. But for the cargo airlines whose main business is aircraft production and maintenance, the total number of flights during the epidemic period is significantly less than usual, so the business volume of such airlines will also have a significant decline, resulting in a decrease in the number of employees.

The Covid-19 outbreak has increased the profits of most U.S. cargo airlines. Note that there is no profit data of the Jet Aviation Flight Services in the third quarter of 2020 in the Bureau of Transportation Statistics datasets. Figure 13 and 14 show that the actual trends of the top four U.S. cargo airlines are all above zero, which means that these airlines are still making profits during the Covid-19 outbreak, and this is the opposite situation of the top four U.S. passenger airlines. Table 9 shows that from the fourth quarter in 2019 to the first quarter in 2020, the predicted profit of Federal Express Corporation is greater than its actual profit. However, the actual profit of Federal Express Corporation was greater than its predicted profit. Moreover, Figure

14 shows that the actual profit trend of Federal Express Corporation reached the second peak within four years in the third quarter of 2020, but its predicted trend went down in this time period. The increase in profit of Federal Express Corporation is due to it having seized the huge opportunities in the booming e-commerce market and has become a market leader. Also, during the Covid-19 outbreak,there were many additional flights to transport epidemic prevention materials such as masks, personal protective equipment, ventilators, oxygen canisters and medical shelters. 2020 saw the highest flight frequency of Federal Express Corporation within seventy years (FedEx Corporation. 2020). Covid-19 has also had a positive impact on the United Parcel Service and the Kalitta Air LLC. Table 9 shows from the first quarter in 2020 to the third quarter in 2020, the actual profits are all greater than the predicted profits. For the Kalitta Air LLC, the predicted profit of the third quarter in 2020 is around -$8.09 thousand dollars, but the actual profit in this quarter is around $80.73 thousand dollars with -1098% percentage difference. However, Covid-19 had brought a negative impact to Jet Aviation Flight Services. Although we are missing the data of the third quarter in 2020, judging from the second quarter in 2020, the predicted profit is greater than the actual profit in this time period with -23.21% percentage difference. The decline in profit of Jet Aviation Flight Services is due to the lower aircraft productivity in order to better control costs at the beginning of the Covid-19 outbreak. Furthermore, the temporary closure for some of the cooperative suppliers and company's facilities would affect their ability to fulfill the contract. The resulting increase in costs reduced the profit of Jet Aviation Flight Services (General Dynamics. 2020).

Covid-19 has brought benefits to the U.S. cargo airlines. Due to the increasing demand for transportation of anti-epidemic materials and the increasing willingness of online shopping, the order of cargo airlines has increased significantly during the epidemic period. Therefore, the number of flights of cargo airlines is much higher than during the non-epidemic period, which has resulted in a substantial increase in cargo airline profits.

The counterfactual exercise assumes that if Covid-19 did not exist, the same econometric model of the top four U.S. passenger airlines and the top four U.S. cargo airlines would continue. When Covid-19 did exist, passenger airlines and cargo

airlines in the U.S. airline industry had performed differently. In general, Covid-19 has a negative impact on the U.S. passenger airlines. When Covid-19 occurred, the actual total employees and profits of the top four U.S. passenger airlines decreased significantly compared to their predicted results. It is shocking to see that even the profits of the top four U.S. passenger airlines had dropped so much during the Covid-19 outbreak. Jet Aviation Flight Services did not perform as well as the other three cargo airlines during the epidemic. But generally, Covid-19 had brought benefits to the U.S. cargo airlines, because when there are no significant changes in the total employees, and the top four U.S. cargo airlines can still increase their profits during the Covid-19 outbreak.

Chapter 5: Conclusion

In this paper, I have studied the economic impacts of Covid-19 on the U.S. airline industry using two variables: the total employees and the profit of the U.S. airline industry during the pandemic. I download Schedule P-1.2 and Schedule P-1 (a) from year 2016 to year 2020 of Bureau of Transportation Statistics anduse the ARMA model to generate counterfactual data of the total employees and the profits in the U.S. airline industry. Schedule P-1(a) shows monthly total employeedata in U.S. airlines, and Schedule P-1.2 shows quarterly profit and loss statements of the U.S. airlines with annual operating revenues of $20 million or more. I thenseparate the analysis of the U.S. airline industry into passenger airline and cargo airline and carried out data prediction and data analysis on each respectively. Then I compare the predicted data with the actual data, which reveal the true economic impact of Covid-19 on the U.S. airline industry. The data of total employees and the data of profit predict by the U.S. cargo airlines are lower than the actual data. This demonstrates that Covid-19 has positive economic impacts on the U.S. cargo airline. However, the data of the U.S. passenger airline and the data of the U.S. cargo airline are the exact opposite. The data of total employees and the data of profit predicted by the U.S. passenger airlines are much higher than the actual data, actively demonstrating the huge negative economic impact Covid-19 had on theU.S. passenger airlines. Therefore, through the data analysis, it can be concluded that the cumulative damage of Covid-19 on theU.S. airline industry as a whole was huge. As comparisons between the predicted and the actual data show net loss as a result of Covid-19 as the damage done to the U.S. passenger airlinesfar exceeded the benefits U.S. cargo airlinesderived from increased cargo needs.

There are some common findings between my data results and existing literature. Eichenbaum et al. (2020) suggest that containment policies of pandemics will reduce consumption and employment. As the government starts to launch them to control the Covid-19 pandemic, the economy is likely to lead to recession. The results from my data chapter proves the author's point. The U.S. government starts to launch containment policies to control Covid-19 in February 2020. My data chapter demonstrates that the whole U.S. airline industry has been down-trending since February 2020. Priyadarshini et al. (2020) argues that due to Covid-19, many of the industries have suffered great losses, along with employment rate decline at the same

time. Among them, the tourism industry is most affected by the outbreak of covid-19. According to my data chapter, it can be concluded that the decline of the profit and the total employees in the U.S. passenger airline can be an indication that Covid-19 has negative impacts on the U.S. tourism industry. Sobieralski, J. B. (2020) conducts research of the airline employment in the U.S. with time-series analysis. This article shows that air transportation employment will decline given production falls caused by significant uncertainty events, including Gulf Crisis, Asian Crisis, 9/11 Attacks, SARS, and Great Recessions. According to my data analysis, the total employees in the U.S. airline industry also has a significant decline under the impact of Covid-19. From February 2020 when the U.S. government starts to control the Covid-19 until September 2020, the total number of employees in the U.S. airline industry fell from around 757 thousands of employees to around 701 thousand employees with a 7.4% decline rate. I agree with the author, the huge decline of the total employees in the U.S. airline industry is also due to production declines as the U.S. government's control of Covid-19 has led to a great loss of customers in the U.S. airline industry, resulting the decline in the productivity. Adrinenne et al. (2020) points out that the aircraft grounded cause by Covid-19 increases the cost of airlines and reduces the profits of airlines. My data analysis for the profit of the U.S. airline industry also backs up this point. In the fourth quarter of 2019, the whole U.S. airline industry has made a total profit of $4590 thousand dollars. But in the third quarter of 2020, the U.S. airline industry has lost around -$14856 thousand dollars with -423% percentage difference. The above data proves the cost of the grounding aircrafts in the U.S airline industry is very high, and the losses are huge.

During the Covid-19 outbreak, the main reason for the huge difference between the total employees and profits of passenger airlines and cargo airlines is the difference between the Supply Chain. Due to the emergence of this epidemic, the U.S. government has introduced many policies to restrict tourism, resulting in a significant reduction in the number of passengers on international and local flights of passenger airlines. For passenger airlines, the number of passengers determines their supply. Therefore, when supply decreased, passenger airline fares will become very expensive. The price of air tickets during the epidemic is several times higher than usual. The reduction of supply will also lead to the large number of grounding of passenger airlines, resulting in the loss of profits and the loss of employees. On the contrary,

with the deterioration of the epidemic in the U.S., more and more medical and epidemic prevention materials enter the States, which means the increase of cargo supply. Therefore, when the supply increases, the flights of cargo airlines will increase, so the profits and the number of employees will increase significantly.

Tables and Figures

Figure 1.

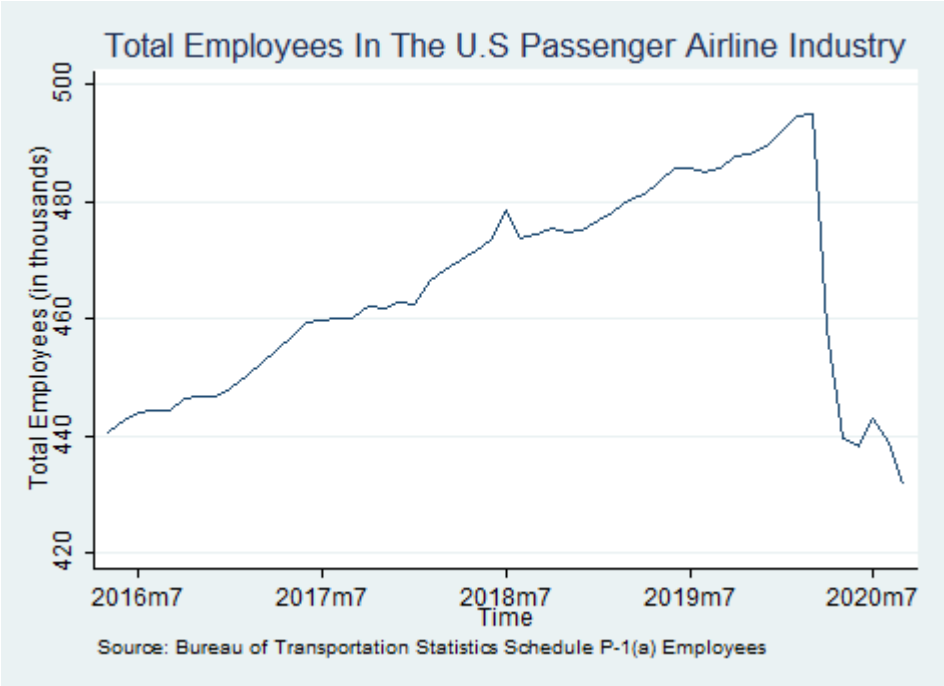

Figure 2

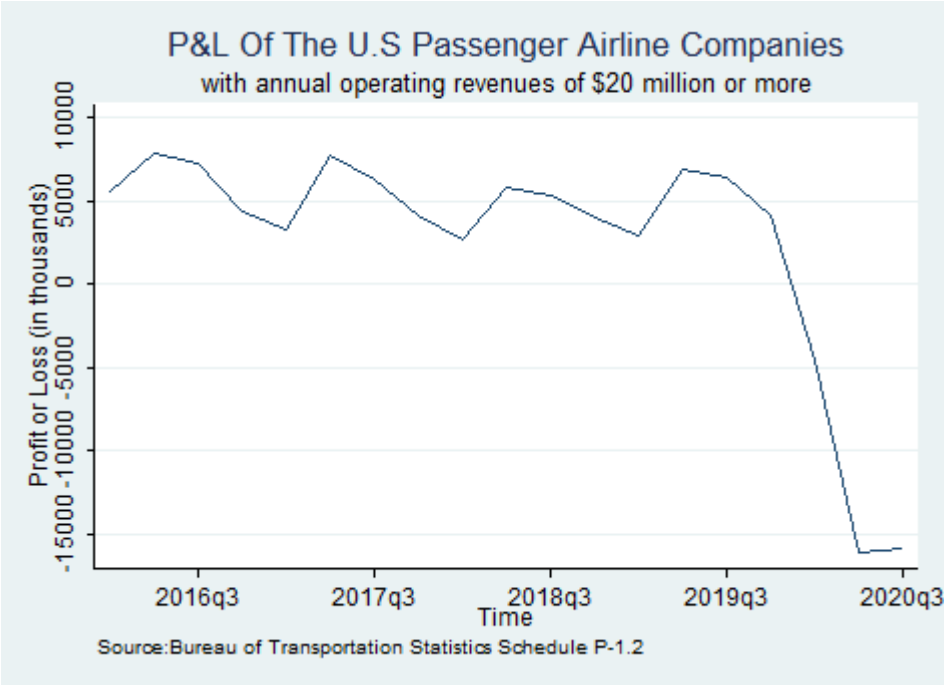

Figure 3

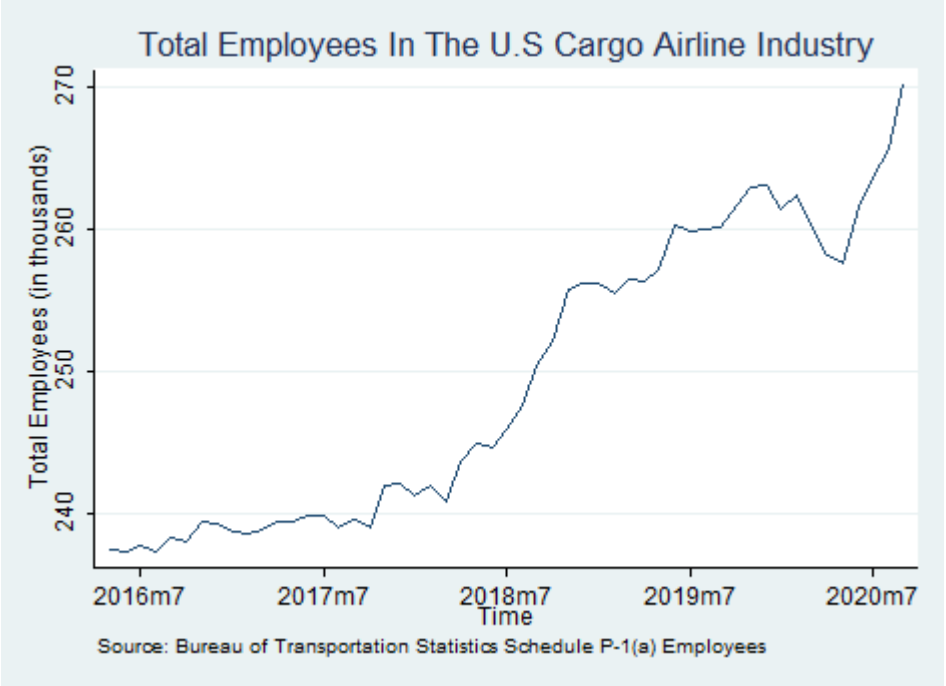

Figure 4

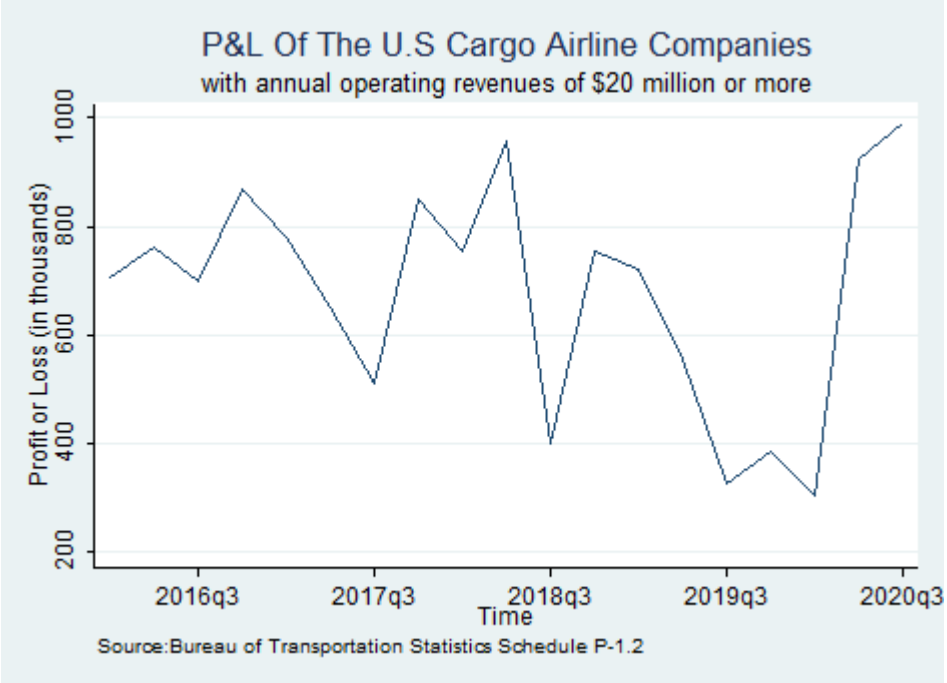

Figure 5

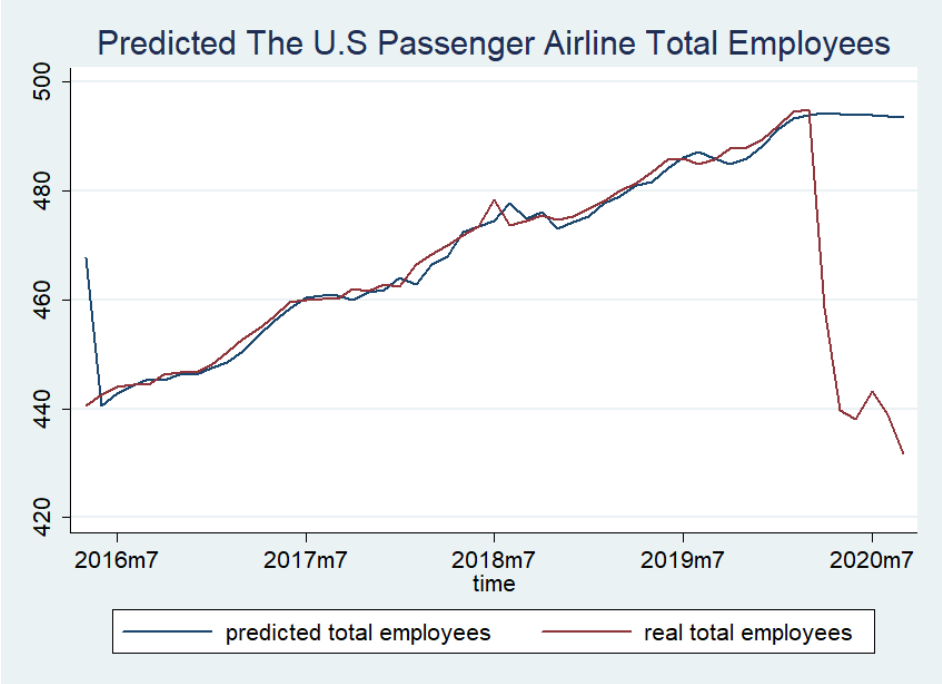

Figure 6

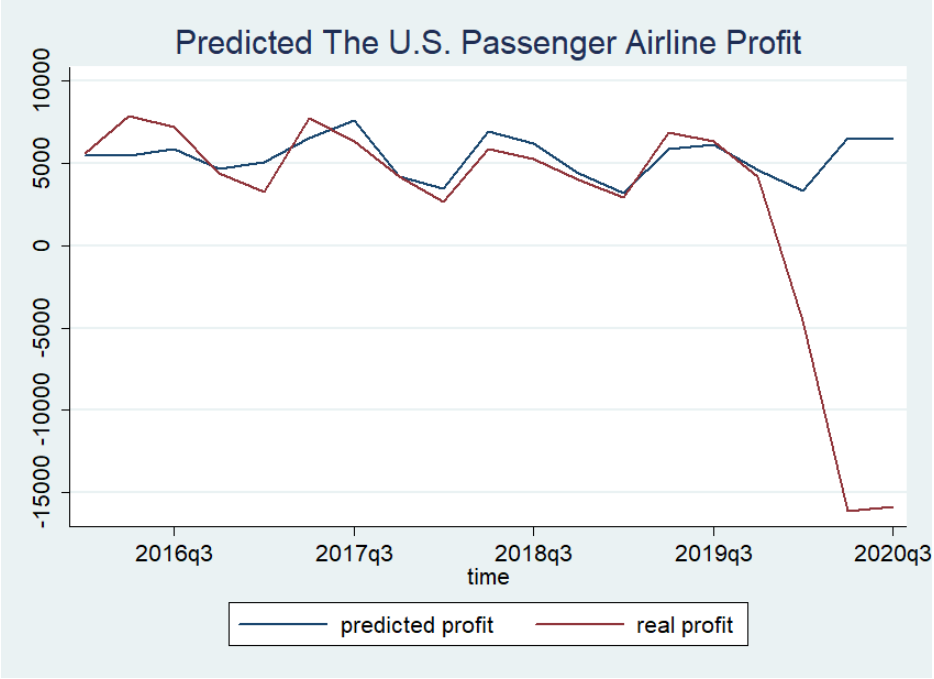

Figure 7

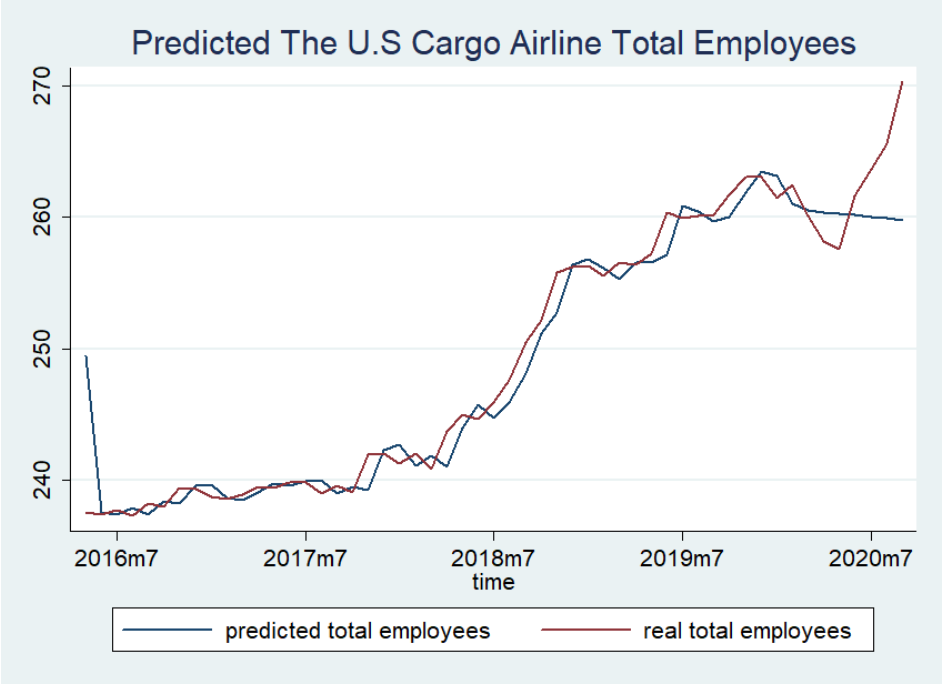

Figure 8

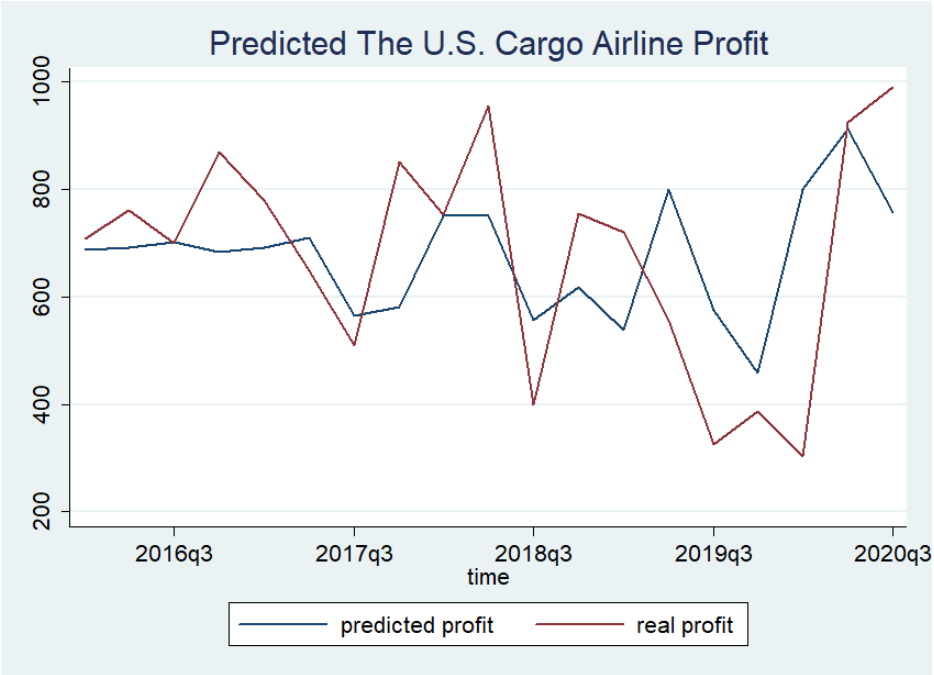

Figure 9

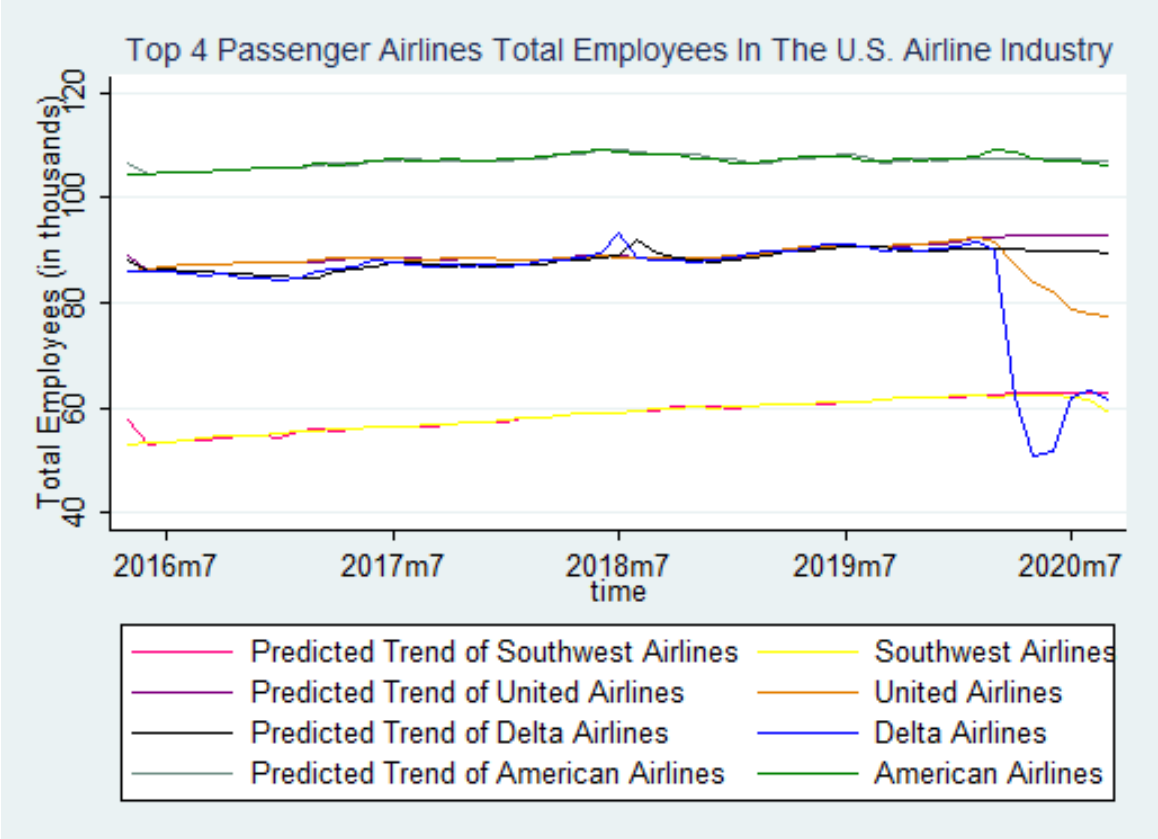

Figure 10

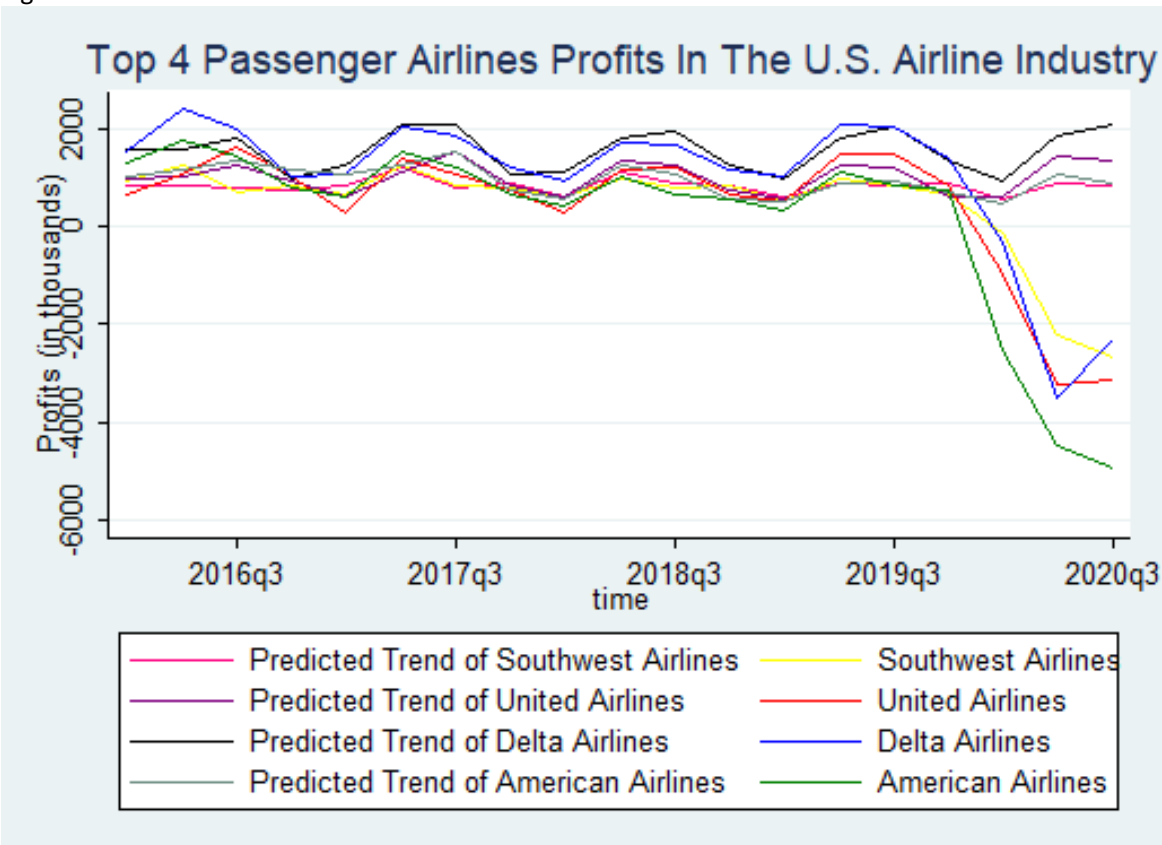

Figure 11

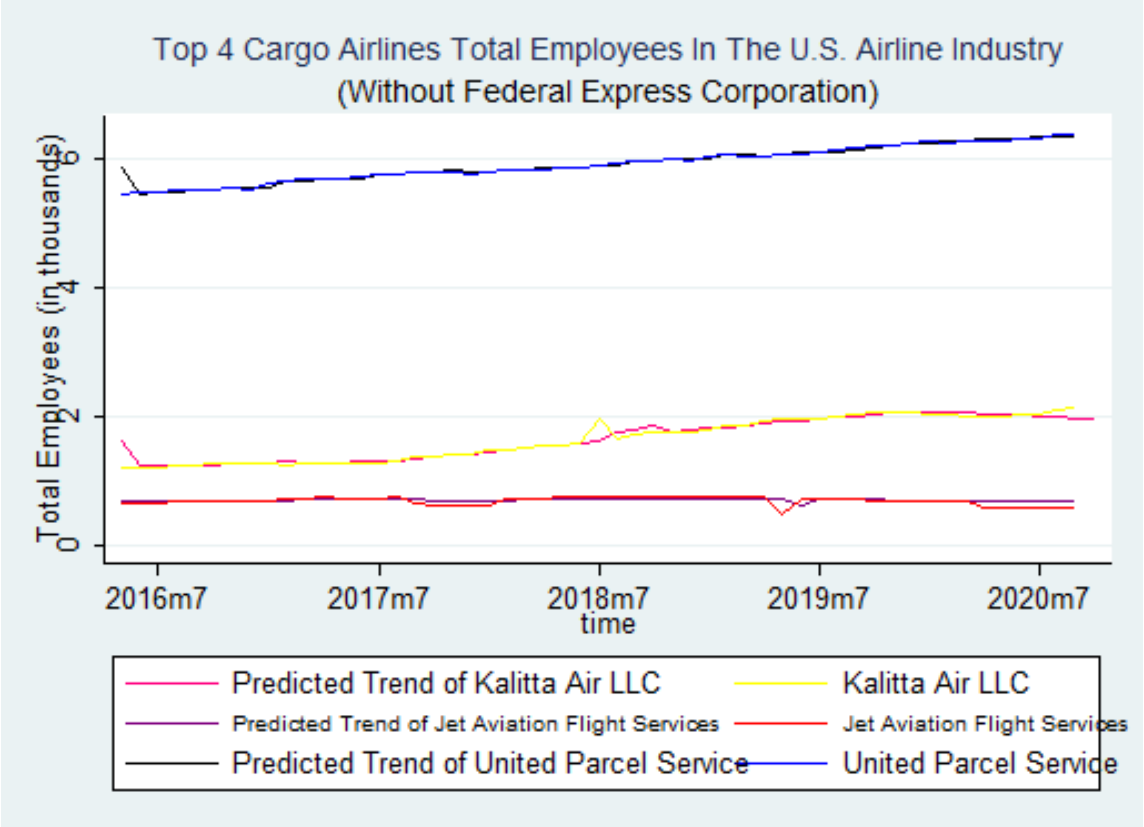

Figure 12

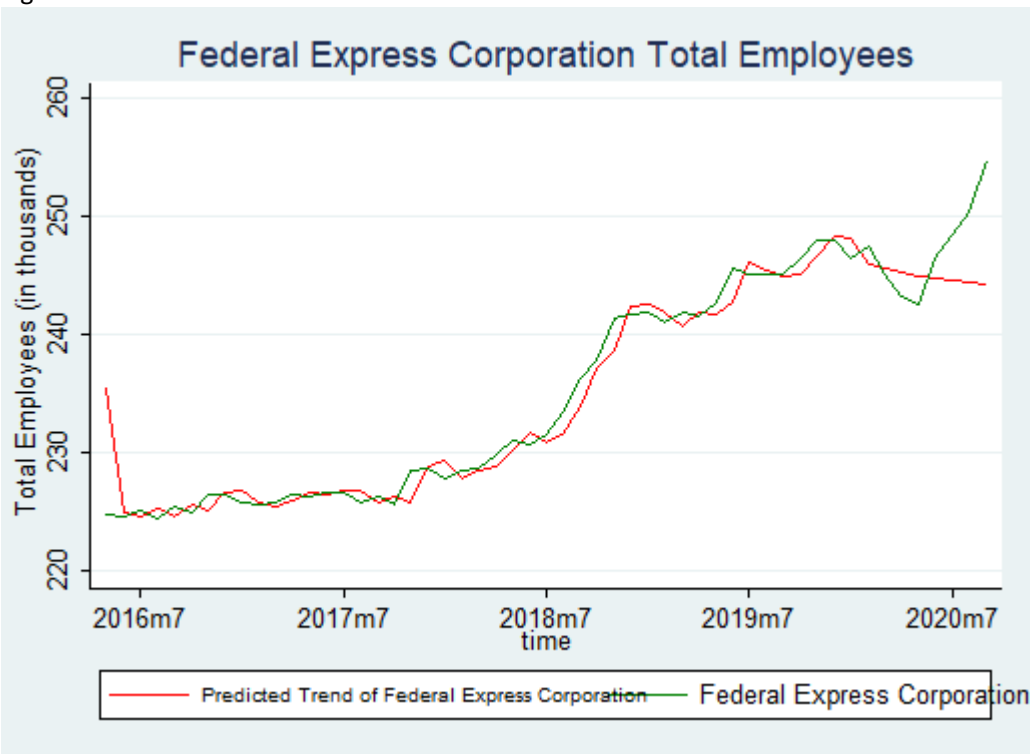

Figure 13

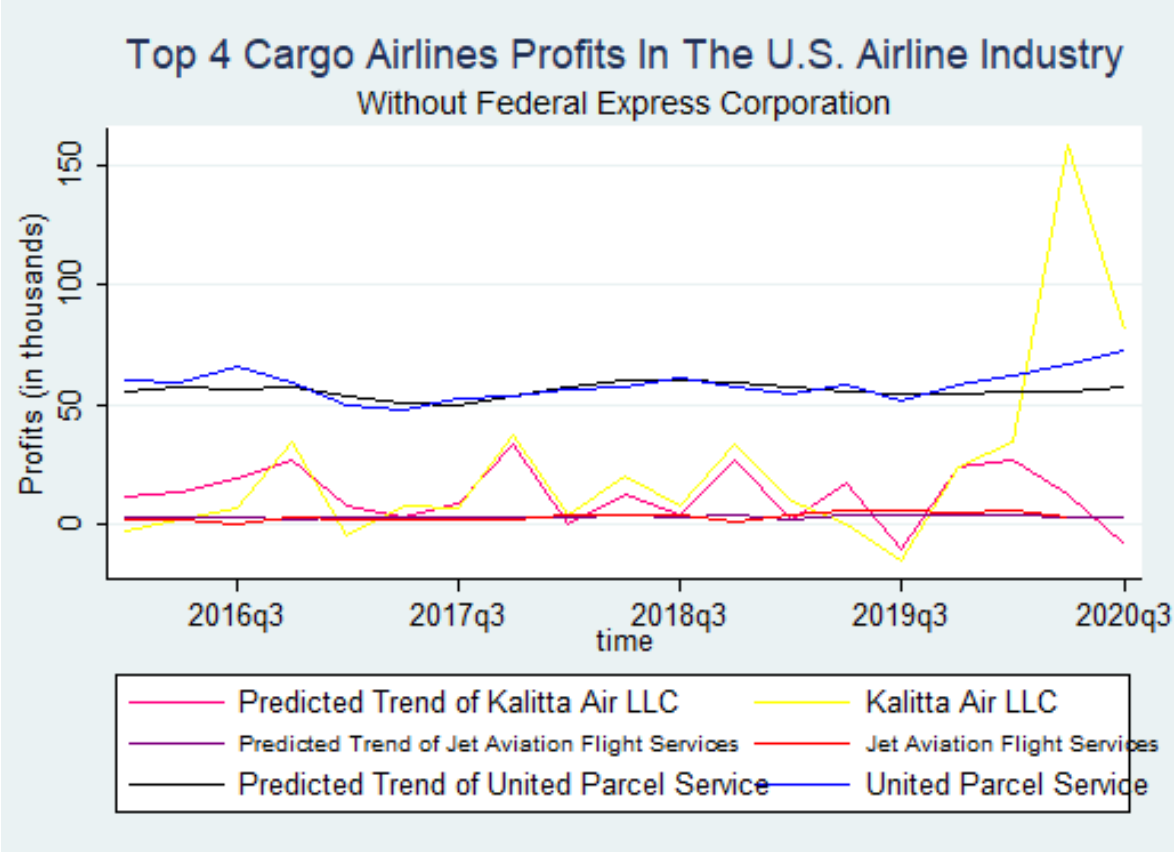

Figure 14

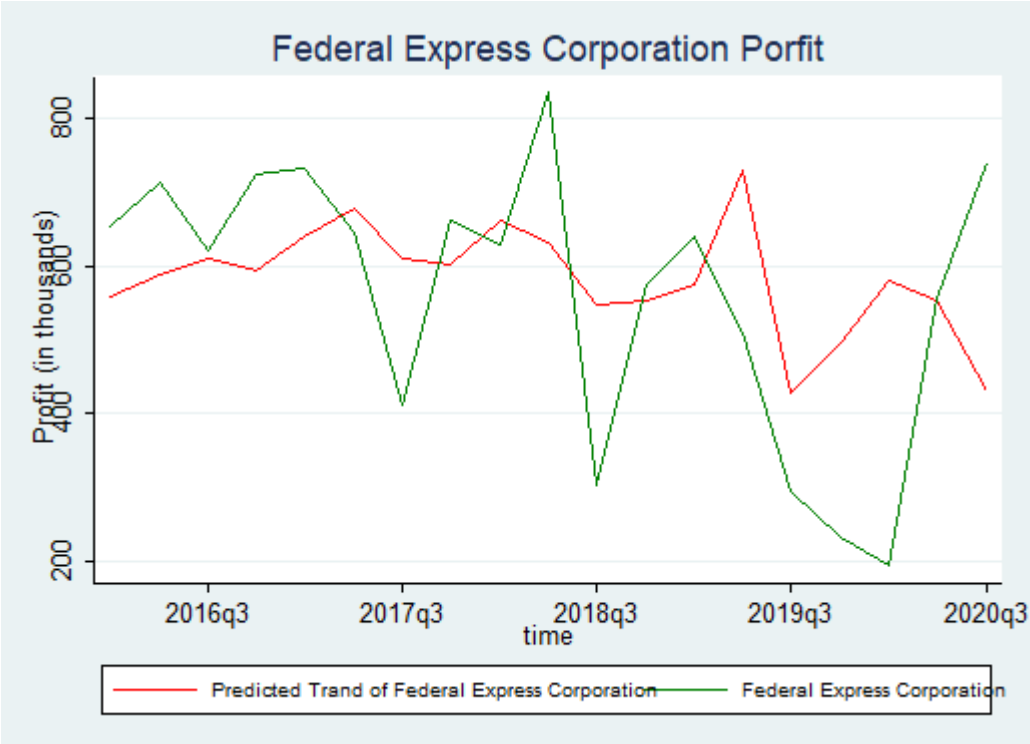

Figure 15

ARIMA regression

Sample: 2016m5 - 2020m2 — Number of obs = 46

Wald chi2(2) = 1034.65

Log likelihood = -409.4268 — Prob > chi2 = 0.0000

EMPTOTAL	Coef.	OPG Std. Err.	z	P>|z|	[95% Conf.	Interval]
EMPTOTAL						
_cons	467938.6	25517.7	18.34	0.000	417924.9	517952.4
ARMA						
ar						
L1.	.9950474	.0319021	31.19	0.000	.9325204	1.057574
ma						
L3.	.6461926	.1010689	6.39	0.000	.4481011	.8442841
/sigma	1641.256	193.9103	8.46	0.000	1261.199	2021.313

Figure 16

ARIMA regression

Sample: 2016q1 - 2019q4 — Number of obs = 16

Wald chi2(2) = 18.17

Log likelihood = -244.3747 — Prob > chi2 = 0.0001

OP_PROFIT_LOSS	Coef.	OPG Std. Err.	z	P>|z|	[95% Conf.	Interval]
OP_PROFIT_LOSS						
_cons	5651261	1484193	3.81	0.000	2742297	8560225
ARMA						
ar						
L4.	.8124124	.1933828	4.20	0.000	.4333892	1.191436
ma						
L1.	.485548	.2792081	1.74	0.082	-.0616899	1.032786
/sigma	903494.6	195217.7	4.63	0.000	520874.9	1286114

Figure 17

ARIMA regression

Sample: 2016m5 - 2020m2 — Number of obs = 46

Wald chi2(2) = 1215.75

Log likelihood = -396.0214 — Prob > chi2 = 0.0000

EMPTOTAL	Coef.	OPG Std. Err.	z	P>|z|	[95% Conf.	Interval]
EMPTOTAL						
_cons	249473.1	10806.52	23.09	0.000	228292.7	270653.5
ARMA						
ar						
L1.	.9911361	.0285556	34.71	0.000	.9351681	1.047104
ma						
L2.	.2216663	.155184	1.43	0.153	-.0824888	.5258213
/sigma	1262.634	132.9024	9.50	0.000	1002.15	1523.118

Figure 18

ARIMA regression

Sample: 2016q1 - 2019q4 — Number of obs = 16

Wald chi2(2) = 1.43

Log likelihood = -214.4886 — Prob > chi2 = 0.4887

OP_PROFIT_LOSS	Coef.	OPG Std. Err.	z	P>|z|	[95% Conf.	Interval]
OP_PROFIT_LOSS						
_cons	689655.6	24559.23	28.08	0.000	641520.4	737790.8
ARMA						
ar						
L1.	.2117233	.2411524	0.88	0.380	-.2609268	.6843733
ma						
L3.	-.8820496	1.19567	-0.74	0.461	-3.225521	1.461421
/sigma	142369.3	67965.92	2.09	0.018	9158.554	275580

Table 1 The coefficient and the log likelihood of the minimum AIC value.

	Coefficient	Log Likelihood
Passenger Airline Profit	5651261	-224.3747
Cargo Airline Profit	689655.6	-214.4886
Passenger Airline Total Employees	467938.6	-409.4268
Cargo Airline Total Employees	249473.1	-396.0214

Table 2 Total employees in the U.S. passenger airlines

	Actual Data	Predicted Data	% Difference[1]
2020M2	494.50601	493.26337	0.25%
2020M3	494.95599	494.01962	0.19%
2020M4	458.504	494.25821	-7.23%
2020M5	439.64401	494.11633	-11.02%
2020M6	438.134	493.97519	-11.30%
2020M7	443.186	493.83484	-10.26%
2020M8	438.89301	493.69522	-11.10%
2020M9	431.798	493.55634	-12.51%

Table 3Profits in the U.S. passenger airlines

	Actual Data	Predicted Data	% Difference
2019Q4	4202.5508	4573.1929	-8.10%
2020Q1	-4533.7217	3302.5339	-237.28%
2020Q2	-16156.728	6521.9868	-347.73%
2020Q3	-15847.32	6491.5322	-344.12%

Table 4Total employees in the U.S. cargo airlines

	Actual Data	Predicted Data	% Difference
2020M2	262.44699	261.00482	0.55%
2020M3	260.07101	260.50266	-0.17%
2020M4	258.189	260.38217	-0.84%
2020M5	257.59299	260.26303	-1.03%
2020M6	261.58899	260.14517	0.56%
2020M7	263.638	260.02863	1.39%
2020M8	265.59299	259.91336	2.19%
2020M9	270.26999	259.79935	4.03%

Table 5 Profits in the U.S. cargo airlines

	Actual Data	Predicted Data	% Difference
2019Q4	387.23035	458.47586	-15.54%
2020Q1	304.01434	799.65588	-61.98%
2020Q2	924.138	912.78375	1.24%
2020Q3	990.86127	756.3031	31.01%

[1]%Difference = (Actual - Predicted)/Predicted

Table 6 Total employees in thetop four U.S. Passenger Airlines

		Actual Data	Predicted Data	%Difference
2020m2	American Airlines	107.905	107.4628	0.41%
2020m3	American Airlines	109.108	107.4419	1.55%
2020m4	American Airlines	108.579	107.4088	1.09%
2020m5	American Airlines	107.346	107.3711	-0.02%
2020m6	American Airlines	107.252	107.3328	-0.08%
2020m7	American Airlines	107.028	107.2954	-0.25%
2020m8	American Airlines	106.544	107.2598	-0.67%
2020m9	American Airlines	106.17	107.2261	-0.98%
2020m2	Delta Airlines	91.416	90.50112	1.01%
2020m3	Delta Airlines	89.98	90.36874	-0.43%
2020m4	Delta Airlines	62.01	90.21732	-31.27%
2020m5	Delta Airlines	50.984	90.08026	-43.40%
2020m6	Delta Airlines	51.468	89.95236	-42.78%
2020m7	Delta Airlines	62.076	89.83343	-30.90%
2020m8	Delta Airlines	63.346	89.72279	-29.40%
2020m9	Delta Airlines	61.51	89.61989	-31.37%
2020m2	United Airlines	92.249	92.37109	-0.13%
2020m3	United Airlines	91.563	92.61883	-1.14%
2020m4	United Airlines	87.369	92.77563	-5.83%
2020m5	United Airlines	83.723	92.87003	-9.85%
2020m6	United Airlines	82.228	92.91611	-11.50%
2020m7	United Airlines	78.809	92.9264	-15.19%
2020m8	United Airlines	77.901	92.90998	-16.15%
2020m9	United Airlines	77.221	92.87386	-16.85%
2020m2	Southwest Airlines	62.436	62.4034	0.05%
2020m3	Southwest Airlines	62.081	62.52993	-0.72%
2020m4	Southwest Airlines	62.191	62.60935	-0.67%
2020m5	Southwest Airlines	62.345	62.65459	-0.49%
2020m6	Southwest Airlines	62.288	62.67487	-0.62%
2020m7	Southwest Airlines	62.044	62.67697	-1.01%
2020m8	Southwest Airlines	61.688	62.66585	-1.56%
2020m9	Southwest Airlines	59.028	62.64516	-5.77%

Table 7Profits in the top four U.S. Passenger Airlines

		Actual Data	Predicted Data	%Difference
2019q4	American Airlines	746.0147	716.2412	4.16%
2020q1	American Airlines	-2535.836	471.5905	-637.72%
2020q2	American Airlines	-4459.138	1079.739	-512.98%
2020q3	American Airlines	-4945.287	879.0322	-662.58%
2019q4	Delta Airlines	1395.768	1371.919	1.74%
2020q1	Delta Airlines	-326.044	942.7771	-134.58%
2020q2	Delta Airlines	-3517.502	1879.52	-287.15%
2020q3	Delta Airlines	-2292.385	2101.685	-209.07%
2019q4	United Airlines	861.7034	609.4992	41.38%
2020q1	United Airlines	-971.6791	622.3608	-256.13%
2020q2	United Airlines	-3225.521	1436.054	-324.61%
2020q3	United Airlines	-3108.527	1337.088	-332.48%
2019q4	Southwest Airlines	664.733	890.9935	-25.39%
2020q1	Southwest Airlines	-109.526	544.2033	-120.13%
2020q2	Southwest Airlines	-2217.663	888.0048	-349.74%
2020q3	Southwest Airlines	-2658.234	826.1263	-421.77%

Table 8Total employees in the top four U.S. cargo Airlines

		Actual Data	Predicted Data	%Difference
2020m2	United Parcel Service	6.264	6.279998	-0.25%
2020m3	United Parcel Service	6.279	6.293893	-0.24%
2020m4	United Parcel Service	6.279	6.307268	-0.45%
2020m5	United Parcel Service	6.284	6.320165	-0.57%
2020m6	United Parcel Service	6.306	6.332562	-0.42%
2020m7	United Parcel Service	6.324	6.344448	-0.32%
2020m8	United Parcel Service	6.401	6.355811	0.71%
2020m9	United Parcel Service	6.379	6.366638	0.19%
2020m2	Jet Aviation Flight Services	0.702	0.7077674	-0.81%
2020m3	Jet Aviation Flight Services	0.71	0.7111896	-0.17%
2020m4	Jet Aviation Flight Services	0.605	0.7122773	-15.06%
2020m5	Jet Aviation Flight Services	0.605	0.712623	-15.10%
2020m6	Jet Aviation Flight Services	0.603	0.7127329	-15.40%
2020m7	Jet Aviation Flight Services	0.593	0.7127678	-16.80%
2020m8	Jet Aviation Flight Services	0.59	0.7127789	-17.23%
2020m9	Jet Aviation Flight Services	0.593	0.7127824	-16.80%
2020m2	Kalitta Air LLC	2.032	2.068643	-1.77%
2020m3	Kalitta Air LLC	2.013	2.059383	-2.25%
2020m4	Kalitta Air LLC	2.005	2.043593	-1.89%
2020m5	Kalitta Air LLC	2.017	2.043698	-1.31%
2020m6	Kalitta Air LLC	2.03	2.03068	-0.03%
2020m7	Kalitta Air LLC	2.046	2.016107	1.48%
2020m8	Kalitta Air LLC	2.099	2.002887	4.80%
2020m9	Kalitta Air LLC	2.143	1.985024	7.96%
2020m2	Federal Express Corporation	247.414	245.9973	0.58%
2020m3	Federal Express Corporation	245.01	245.5077	-0.20%
2020m4	Federal Express Corporation	243.278	245.2324	-0.80%
2020m5	Federal Express Corporation	242.615	244.9835	-0.97%
2020m6	Federal Express Corporation	246.492	244.7842	0.70%
2020m7	Federal Express Corporation	248.402	244.6017	1.55%
2020m8	Federal Express Corporation	250.325	244.4339	2.41%
2020m9	Federal Express Corporation	254.684	244.274	4.26%

Table 9 Profits in the top four U.S. cargo Airlines

		Actual Data	Predicted Data	%Difference
2019q4	United Parcel Service	58.40615	54.30883	7.54%
2020q1	United Parcel Service	61.81858	55.41353	11.56%
2020q2	United Parcel Service	66.74216	55.82959	19.55%
2020q3	United Parcel Service	72.95248	57.14337	27.67%
2019q4	Jet Aviation Flight Services	5.01804	4.687103	7.06%
2020q1	Jet Aviation Flight Services	5.84006	3.979229	46.76%
2020q2	Jet Aviation Flight Services	2.83201	3.687881	-23.21%
2020q3	Jet Aviation Flight Services	-	3.567967	-
2019q4	Kalitta Air LLC	24.41976	24.19483	0.93%
2020q1	Kalitta Air LLC	34.45516	26.867	28.24%
2020q2	Kalitta Air LLC	157.7099	12.61048	1150.63%
2020q3	Kalitta Air LLC	80.72759	-8.091476	-1097.69%
2019q4	Federal Express Corporation	230.913	496.0551	-53.45%
2020q1	Federal Express Corporation	193.245	578.6462	-66.60%
2020q2	Federal Express Corporation	556.015	552.2526	0.68%
2020q3	Federal Express Corporation	739.888	430.7893	71.75%

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Appendix

These are all the AIC results, and the minimum AIC indicated in (*).

AIC results of the total employees in the U.S. passenger airline

	q (MA)				
p (AR)	0	1	2	3	4
0		966.78938	934.18703	936.2004	905.43817
1	834.07702	833.17832	832.14083	*824.85356	832.30931
2	831.42977	836.01735	875.46285	857.65145	874.95629
3	828.72123	883.79462	889.48522	892.71229	900.73137
4	827.30314	886.70498	882.60125	901.32046	925.95496

AIC results of the total employees in the U.S. cargo airline

	q (MA)				
p (AR)	0	1	2	3	4
0		919.03462	889.70428	861.04083	851.65974
1	798.49029	799.25434	*****798.04281	799.61281	799.48626
2	798.71286	800.3774	838.94326	840.66142	839.67046
3	798.4672	843.89117	853.50253	867.91876	864.07968
4	800.10402	847.0036	843.53683	878.71118	884.2833

AIC results of the profits in the U.S. passenger airline

	q (MA)				
p (AR)	0	1	2	3	4
0		506.64888	506.4369	509.56655	505.28131
1	507.33089	508.21519	506.34025	506.18927	509.3756
2	502.7215	503.04976	500.58226	501.12073	497.86414
3	504.69177	508.14558	506.11288	505.99582	500.85091
4	498.75755	*****494.74944	497.6455	497.61022	497.56887

AIC results of the profits in the U.S. cargo airline

	q (MA)				
p (AR)	0	1	2	3	4
0		435.82917	437.42298	437.19132	439.03617
1	435.74303	437.69773	437.63365	*****434.9772	436.02
2	437.63604	437.47599	437.85104	435.57546	436.46647
3	439.11436	436.76797	437.5932	flat log likelihood encountered, cannot find uphill direction	436.6175
4	438.91628	435.80169	435.80318	435.40222	436.43083

The AIC results of the profits for United Parcel Service

	q (MA)				
p (AR)	0	1	2	3	4
0		117.56663	118.70375	118.87077	120.88551
1	116.47748	117.96945	121.0816	120.88273	121.94478
2	117.82416	118.56825	121.05762	93.728027	98.632548
3	119.51243	121.27963	123.24943	123.51272	93.716479
4	120.92112	93.573409	123.48496	*92.60728	94.087036

The AIC results of the profits for Kalitta Air LLC

	q (MA)				
p (AR)	0	1	2	3	4
0		133.76148	133.9523	131.55633	133.57204
1	134.13892	133.59215	135.5215	128.92946	130.42684
2	136.07519	135.38248	135.51156	128.2407	130.36963
3	130.68191	135.51156	126.09777	127.84737	127.74626
4	127.30543	126.76089	127.5244	*125.8767	127.46315

The AIC results of the profits for Jet Aviation Flight Services

	q (MA)				
p (AR)	0	1	2	3	4
0		61.691446	63.741947	62.139329	61.76155
1	*60.92639	flat log likelihood encountered, cannot find uphill direction	64.906412	61.299533	65.73499
2	62.872926	62.509224	62.860844	64.942843	63.209153
3	64.40073	62.82941	64.702105	62.460693	62.439175
4	64.34372	66.071217	64.505665	65.027336	63.911769

The AIC results of the profits for Federal Express Corporation

	q (MA)				
p (AR)	0	1	2	3	4
0		213.07479	214.7925	214.36012	214.29986
1	212.96029	flat log likelihood encountered, cannot find uphill direction	216.80421	216.33755	218.00998
2	214.94235	216.64035	215.24588	218.5125	212.92875
3	216.90568	218.28838	216.23181	217.87067	213.39892
4	215.47465	217.46177	216.37586	*212.6001	212.61408

The AIC results of the profits for American Airline

	q (MA)				
p (AR)	0	1	2	3	4
0		238.70066	240.66305	242.67297	244.57864
1	239.44546	240.68955	242.2972	243.40539	236.34895
2	240.18532	242.08214	243.99553	243.81318	244.15343
3	241.65002	240.22651	240.71776	241.24969	242.04921
4	237.15086	*236.1333	237.24506	243.27435	246.534143

The AIC results of the profits for United Airlines

	q (MA)				
p (AR)	0	1	2	3	4
0		240.17598	236.71562	238.64296	240.04137
1	241.89753	243.05401	238.70365	238.81442	240.82187
2	234.36964	236.22	230.44304	232.41614	238.80324
3	235.95203	242.15526	*232.2413	232.24663	241.92385
4	233.44533	234.93421	232.64241	236.92254	233.66798

The AIC results of the profits for Delta Airlines

	q (MA)				
p (AR)	0	1	2	3	4
0		242.41194	239.28465	234.03152	236.03446
1	245.13955	244.06063	240.68611	245.81685	238.00878
2	230.34927	232.34462	225.30834	227.23131	235.884311
3	232.33785	233.7391	225.76546	224.1344	242.22566
4	229.5664	226.57205	*223.6878	230.33678	226.567648

The AIC results of the profits for Southwest Airlines

	q (MA)				
p (AR)	0	1	2	3	4
0		218.14482	220.01482	219.1148	220.58042
1	218.50092	220.04545	222.08624	218.66343	222.91283
2	220.262	221.84573	218.79946	216.83737	214.06422
3	219.04007	217.46403	218.68601	221.64392	220.22668
4	*212.4952	214.31252	214.2881	222.08862	219.679402

The AIC results of the total employees for United Parcel Service

	q (MA)				
p (AR)	0	1	2	3	4
0		-56.625427	-91.900428	-114.28965	-133.17372
1	-188.76507	-189.72319	-189.30368	-189.87631	-188.06835
2	-191.07554	-186.80492	-185.93839	-147.77968	-152.83864
3	-192.06223	*-204.4799	-199.85583	-199.29491	-197.76897
4	-193.96996	-135.40722	-199.55365	-202.50162	-107.2408

The AIC results of the total employees for Kalitta Air LLC

	q (MA)				
p (AR)	0	1	2	3	4
0		-14.609716	-37.065679	-55.985331	-55.985331
1	-89.197434	-94.14949	-94.425122	-94.481512	-93.079595
2	-94.568805	-93.044262	-75.932288	-81.293731	-79.493063
3	-93.515581	-98.399918	-72.730417	-94.16742	-96.88034
4	-93.049683	*-102.6688	-75.39645	-88.80902	-91.36678

The AIC results of the total employees for Jet Aviation Flight Services

	q (MA)				
p (AR)	0	1	2	3	4
0		-139.1269	-138.15652	-136.78559	-135.00466
1	*-140.1779	-138.64326	-136.73016	-134.92095	-136.48724
2	-138.6844	-136.69732	-139.70009	-138.04132	-135.76541
3	-136.71394	-139.10272	-137.70528	-134.00808	-133.97686
4	-134.85755	-137.69622	-135.76506	-133.76973	-133.47763

The AIC results of the total employees for Federal Express Corporation

	q (MA)				
p (AR)	0	1	2	3	4
0		277.44905	241.5343	218.7652	203.58991
1	155.64773	155.69346	155.67197	157.65932	159.54124
2	154.88997	*146.9315	148.9314	152.92235	199.87969
3	155.21835	150.9314	152.84342	152.8051	225.4164
4	157.18394	150.92567	152.82435	151.21825	244.69352

The AIC results of the total employees for American Airline

	q (MA)				
p (AR)	0	1	2	3	4
0		100.52486	73.840012	65.632544	50.268164
1	38.209073	37.475971	39.160992	39.684408	41.545475
2	*36.95846	38.511779	39.664602	39.574459	43.518117
3	38.632029	40.503522	39.419404	39.018251	42.731704
4	40.182255	42.115803	42.831544	41.656607	39.094181

The AIC results of the total employees for United Airlines

	q (MA)				
p (AR)	0	1	2	3	4
0		115.35232	72.157985	52.558305	30.039381
1	11.725331	2.2629522	-3.6576997	-1.8209625	-3.3574827
2	-5.1019614	-3.9526433	-2.582594	-3.3830782	-1.3961942
3	-4.2912747	-3.1442194	-1.4075049	-2.2665596	-0.31945387
4	-2.9435191	-1.2945649	*-5.778833	-2.4788054	-2.4104298

The AIC results of the total employees for Delta Airlines

	q (MA)				
p (AR)	0	1	2	3	4
0		174.81263	162.08346	158.27957	152.12053
1	141.12116	141.02759	143.00078	144.95333	146.72416
2	*140.9916	142.97887	144.83023	146.55319	148.27251
3	142.97959	144.70992	146.65599	172.71474	147.38208
4	144.97755	146.6026	159.89833	141.69368	180.10682

The AIC results of the total employees for Southwest Airlines

	q (MA)				
p (AR)	0	1	2	3	4
0		170.92988	122.24776	96.582864	61.518499
1	18.671835	-2.8687549	-2.4584793	-1.5869473	-2.8110135
2	-6.1910827	18.635413	67.825389	63.759459	51.559203
3	-4.3679124	65.139791	83.569693	94.269626	79.887677
4	*-16.75006	75.707596	78.956907	108.33548	104.29398