Research paper

The impact of government policy responses on airline stock return during the COVID-19 crisis

Suntichai Kotcharin [a], Sakkakom Maneenop [b,*], Anutchanat Jaroenjitrkam [b]

[a] Department of International Business, Logistics and Transport Thammasat Business School Thammasat University, Bangkok, Thailand
[b] Department of Finance Thammasat Business School Thammasat University, Bangkok, Thailand

A B S T R A C T

This study investigates the impact of government policies on the weekly stock returns of 73 global airline companies in 36 countries during the COVID-19 pandemic. Using panel data estimation techniques with country and week fixed effects, we find that the overall government policies, containment and health policies, and stringency policies increase airline stock returns. Economic support policies do not significantly impact the returns. Containment and health policies mitigate the negative effect of the pandemic on airline stock returns, whereas economic support policies strengthen the adverse effect. The government interventions' impact on airline stock returns is heterogeneous based on the airlines' headquarters but not on their ownership structures and business operations. Our empirical findings provide salient insights for protecting airline companies by reflecting on which government policy responses are effective and how governments should invest and prioritize policies. The results also present practical implications for airline managers, investors, and policymakers concerned with the current pandemic and future crises.

1. Introduction

The COVID-19 pandemic has caused enormous economic losses to almost every industry.[1] The pandemic also adversely impacts global financial markets (Baker et al., 2020; Ding et al., 2021; Fahlenbrach et al., 2021; Liu & Yamamoto, 2022; O'Donnell et al., 2021; Ramelli & Wagner, 2020; Topcu & Gulal, 2020). The airline industry is one of the first industries affected by the pandemic and government interventions. Several studies find negative impacts of COVID-19 on airline stocks (Kumari et al., 2022, 2022; Maneenop & Kotcharin, 2020, 2023; Martins & Cró, 2022). For instance, Maneenop and Kotcharin (2020) document global airline negative abnormal returns of 24.42% in the five days following the 11 march 2020 WHO declaration of a global pandemic outbreak.

Governments worldwide have taken various policy responses such as social distancing, school and workplace closures, travel bans, testing policies, and economic measures to stabilize the economy. Such restrictions on social and economic activities resulted in the global stock markets reacting much more forcefully to COVID-19 than to previous health crises (Baker et al., 2020). The Oxford COVID-19 Government

Response Tracker (OxCGRT), developed by Hale et al. (2021), has organized various types of policies and provided public datasets on (1) overall government response, (2) containment and health policy, (3) stringency policy, and (4) economic support policy. Tracking government policy responses around the globe offers an opportunity to explore the impact of the intervention on airline stocks worldwide.

Using this dataset, recent studies can investigate the role of government policy response to financial markets (Aharon & Siev, 2021; Kumari, Kumar, & Pandey, 2022; Kumari, Tiwari, Gupta, & Kumar Pandey, 2022; Kumari, Kumar, & Pandey, 2022; Kumari, Tiwari, Gupta, & Kumar Pandey, 2022, Guedhami et al., 2022, among others). However, they find mixed results. Narayan et al. (2021) find that the announcement of government COVID-19-related policies positively impacts G7 stock market returns. Similarly, Chang et al. (2021) find that containment and health policies positively affect global stock market returns. Kaczmarek et al. (2021) show that travel and leisure companies around the globe benefited from stringent containment and closure interventions. On the other hand, Ashraf (2020) finds that containment and closure measures adversely affect that containment and closure measures hurt international stock market returns. Chen et al. (2020) also

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document that the stringency policy negatively impacted the stock returns of U.S. travel and leisure companies.

Although the literature finds a negative impact of growth in confirmed cases of COVID-19 on stock returns and a significant impact of COVID-19-related policies on financial markets, not much literature studies the moderating effects of government interventions on stock returns. For example, Ashraf (2020) discovers that the announcement of stringent government social distancing measures mitigates the stock market's negative response to the increase in confirmed COVID-19 cases. In addition, existing literature limits their investigation to a few developed countries and analyzes data over a relatively short period (Aharon & Siev, 2021; Ashraf, 2020; Chang et al., 2021). Therefore, research must be conducted on a more extended sample period. Moreover, literature on government response to transportation stock performance is scant and limited in a specific country. For example, Sakawa and Watanabel (2023) find that government policy responses alleviate the negative returns of listed Japanese shipping stocks.

To the best of our knowledge, there is yet to be a study of the impact of government response policies on the airline industry. To fill the gap mentioned above, we examine the effects of government response policies to COVID-19 on the weekly returns of airline companies worldwide. We use COVID-19 data from the Center for Systems Science and Engineering at Johns Hopkins University and government policy response data from Hale et al. (2021). Our final dataset includes 73 publicly listed airlines from 36 countries, with the sample period spanning 48 weeks from January to December 2020.

We find that the overall government policies, containment and health policies, and stringency policies increase airline stock returns. Our results are in line with Chang et al. (2021), Narayan et al. (2021), and Zaremba et al. (2021). Containment and health policies and stringency policies also alleviate the negative effect of the pandemic airline stock returns through the reduction of COVID-19 confirmed cases. On the other hand, economic support policies do not significantly impact the returns and even strengthen the adverse effect. We posit that as people receive financial support from the government, they tend to be less concerned about the pandemic, leading to higher growth in confirmed cases. The government interventions' impact on airline stock returns is heterogeneous based on the headquarters but not on the airline's ownership structures and business operations.

Our study contributes to the existing literature in at least two ways. First, we add to the growing literature which examines the impact of COVID-19 on the transportation industry (Kamal et al., 2022; Maneenop & Kotcharin, 2020, 2023; Merkert & Swidan, 2019; Martins & Cró, 2022; Sakawa & Watanabel, 2023). Globally, this industry facilitates several businesses and supply chains and creates employment. Second, we contribute to the literature on government interventions' role in stock returns. Most studies (Aharon & Siev, 2021; Ashraf, 2020; Kumari et al., 2022, 2022; Guedhami et al., 2022; Narayan et al., 2021) only investigate the impact of government measures on stock returns. We add to the literature by examining the moderating role of policies on airline stock returns. As we explore the effect of government policy responses on subgroups based on airline ownership, business operation, and headquarter location. This provides a better understanding of the impact of such reactions on airline stock returns.

The results of this study suggest the policy implications that can be crucial for governments, policymakers, regulatory bodies, investors, and airline executives in responding to future pandemics. Our study examines the effect of various policies on the airline industry. Therefore, governments and regulatory bodies may assess these effects and consider launching accommodative policies in the future, such as fiscal and monetary policies should be tailored to the airline industry; otherwise, they could not be effective. Besides, the findings reveal which national policy responses are beneficial and how governments should prioritize and enfprce policy issues, for example, vaccination policies can strengthen the airline industry's recovery.

The remaining paper proceeds as follows. We present the literature review in Section 2. Section 3 describes our sample and methodology. We present the study findings in Section 4. Section 5 discusses the findings, while Section 6 concludes.

2. Literature review and hypothesis development

2.1. Government policies in response to the COVID-19 outbreak and the reaction of airline stock returns

The COVID-19 pandemic has significantly impacted financial markets and economic growth (Baker et al., 2020; Ding et al., 2021; Fahlenbrach et al., 2021; Liu & Yamamoto, 2022; O'Donnell et al., 2021; Ramelli & Wagner, 2020; Topcu & Gulal, 2020). Several studies find negative impacts of COVID-19 on airline stocks (Kumari et al., 2022, 2022, pp. 1–15; Maneenop & Kotcharin, 2020, 2023; Martins & Cró, 2022). Governments around the world have designed policies to mitigate pandemic effects. Previous studies explore the impact of such government interventions on financial markets, considering factors such as the capacity of healthcare systems, vaccine effectiveness, duration of social distancing, lockdowns, and containment strategies (Ashraf, 2020; Baker et al., 2020; Phan & Narayan, 2020; Zaremba et al., 2020). For example, Phan and Narayan (2020) suggest that government interventions can placate investors panicking about COVID-19's adverse information. Mainly, they show that stimulus packages prove successful in countries implementing travel bans and lockdowns. Further, Chang et al. (2021) find that implementing lockdowns, containment, and financial policies positively relates to stock market returns. However, they show that travel bans and governments' health system interventions do not significantly impact returns.

As stated earlier, research on the impact of governments' COVID-19 mitigation policies on the airline industry is limited to the short-run effect. Being sensitive to the pandemic, the industry has been severely impacted since the early stages of the outbreak (Maneenop & Kotcharin, 2020). Airlines that can rapidly recover from this disruption will achieve competitive advantages. The speed of their recovery depends on corporate conditions and government support. Amankwah-Amoah et al. (2021) focus on strategic renewal frameworks to enhance corporate resilience to COVID-19. However, government interventions can help firms overcome the adverse effects of disruption and strengthen resilience when disrupted by supply chains (Yang & Xu, 2015). Therefore, we expect that government interventions will increase airline stock returns.

Hypothesis 1a. Government policy responses lead to an increase in airline stock returns.

Airlines may become more or less resilient from government interventions in turbulent times. However, investors anticipate that such interventions will potentially stabilize airline cash flow and stock returns (Kaczmarek et al., 2021). They predict airline prospects based on the post-COVID-19 government measures. Therefore, government interventions may mitigate the adverse effect of rising COVID-19 confirmed cases on airline stock performance.

Hypothesis 1b. Government policy responses mitigate the adverse effect of a rising number of COVID-19 confirmed cases on airline stock performance.

2.2. Other testable hypotheses

According to the financial and economic literature, ownership can affect firm performance. It also influences firms' capital accessibility, value creation, control, and competency (Carney & Dostaler, 2006). Several studies find that state-owned enterprises (SOEs) return less to shareholders, operate less profitably, and use more labor (Dewenter & Malatesta, 2001; Megginson & Netter, 2001). Wu and Xu (2021) show that SOEs perform worse than non-SOEs during the COVID-19 shock.

An increasing number of literature in the transportation field

investigate how state ownership is associated with lower cost efficiency, less profitability (Kutlu & McCarthy, 2016; Oum, Park, Kim, & Yu, 2004), and decreasing market value (Malighetti et al., 2011). Moreover, studies document that a high degree of private ownership results in higher autonomy and less political influence (Oum et al., 2004). Hence, non-SOEs can effectively combat problems and communicate with shareholders to placate them when a crisis occurs. Moreover, they have financial institutions as shareholders, making their corporate governance stronger than that of SOEs (Carney & Dostaler, 2006).

SOEs benefit from government subsidies and support during turbulent times (Faccio et al., 2006; Tao et al., 2017). Investors tend to be aware that SOE airlines enjoy greater resource allocation by governments. On the other hand, non-SOEs may become more vulnerable without government support or measures. Hence, COVID-19 can provide a differing impact based on firms' ownership structure. The marginal benefit from government policy response is likely higher for non-SOEs compared to SOEs. We then hypothesize that government policy responses are likely to weaken the negative impact of COVID-19 on stock returns.

Hypothesis 2. Government policy responses mitigate the adverse effect of a rising number of COVID-19 confirmed cases on non-state-owned airline stocks.

Airline operations may be a reason for the differential impacts of governments' COVID-19 measures. Business operations in the airline industry can be of two types: full-service carriers (FSCs) and low-cost carriers (LCCs). Typically, FSCs have longer routes, higher ticket charges, and larger planes than LCCs.These distinctive features allow FSCs to provide a premium service to customers, increasing their fixed costs. However, LCCs have higher productivity growth, have successfully diversified their product portfolios and entered new markets (Assaf & Josiassen, 2012; Euromonitor, 2010), and generate higher returns-to-scale (Arjomandi et al., 2018). This is supported by the evidence from the shock of September 11, 2001, in which LCCs faced a lower impact and recovered faster than did FSCs (Gillen & Lall, 2003).

FSCs, as bigger employers than LCCs and have higher potential to be SOEs, may benefit from government subsidies and support during turbulent times. Investors tend to be aware that FSCs can appreciate greater resource allocation by governments. On the other hand, LCCs are susceptible without government support or measures. Hence, COVID-19 can provide a differing impact based on the airline business model. The marginal benefit from government policy response tends to be higher for LCCs compared to FSCs. We then hypothesize that government policy responses are likely to weaken the negative impact of COVID-19 on stock returns.

Hypothesis 3. Government policy responses mitigate the adverse effect of a rising number of COVID-19 confirmed cases on low-cost airline stocks.

Our final research question relates to the impact of governments' COVID-19 mitigation interventions on airline stock returns in various regions. Zaremba et al. (2021) suggest that such interventions influence the stock markets in emerging countries, not developed ones. This presents an opportunity to explore how airline stocks in different regions perform after implementing various government interventions to mitigate the pandemic's effect. Notably, the 2007–2008 global financial crisis had varying impacts on the air transportation industry in different regions. The developed markets (the United States, Europe, and Japan) were more affected than others (Dobruszkes and Van Hamme, 2011). Therefore, the degree of impact of any crisis depends on economic growth and the cyclical nature of air travel in such countries. Douglas and Tan (2017) also show that the world's GDP positively correlates with airline financial performance.

The United States and several European countries have deregulated to a great extent, and their airlines are mostly privately owned. Their governments do not provide state aid to these airlines based on the market economy investor principle (Fu et al., 2015). By contrast, many

airlines in North Asia and China are state-owned. Therefore, governments influence resource allocation, but their positions as airline owners or regulators are sometimes ambiguous. Hence, government intervention can benefit Asia-Pacific airline stock returns.

Hypothesis 4. Government policy responses lead to an increase in Asian airlines stock returns.

3. Data and methodology

We obtain data on COVID-19 from the Center for Systems Science and Engineering at Johns Hopkins University. This dataset has been used in recent financial studies (Li et al., 2020; Ling et al., 2020). Following Capelle-Blancard and Desroziers (2020) and Ding et al. (2021), we define $COVID_{c,t}$ as the growth rate in the cumulative number of confirmed cases in country c during week t as follows:

$$COVID_{c,t} = ln\left(1 + cumulative\ cases_{c,t}\right) - ln\left(1 + cumulative\ cases_{c,t-1}\right) \quad (1)$$

As the dataset starts on January 22, 2020, we calculate $COVID_{c,t}$ from January 31, 2020 to December 25, 2020, totaling 48 weeks.

Further, we obtain each country's COVID-19 policy response indices from Hale et al. (2021). There are four such indices: government response index (GRI), containment and health index (CHI), stringency index (SI), and economic support index (ESI). Each index comprises a series of individual policy response indicators. The SI tracks containment and closure measures, including health system activities. It includes closing schools and workplaces, canceling public events, restricting the size of gatherings, halting public transport, implementing stay-at-home requirements, restricting internal movement and international travel, and launching public information campaigns. The CHI expands the SI by including indicators of testing policy, contact tracing, facial covering, vaccination policy, and protection of older individuals. The ESI consists of two individual indicators: income support and debt relief for households. Finally, the GRI is a broad indicator of policy response and includes all the activities above. For each indicator, Hale et al. (2021) create a score by taking and rescaling each ordinal value to its maximum value to generate a score between 0 and 100. Then, these scores are averaged to obtain composite indices. A few countries have policy response indices starting from January 1, 2020, but most have datasets beginning in February.

Government policy responses have generally become stronger throughout the outbreak, particularly from early March to mid-April 2020. In March, China was the first country to strictly respond to the pandemic, followed by countries in Asia-Pacific and Europe. In April, most countries strictly ban international travel, among other policy response schemes. Some governments instantly enhance measures as an outbreak spreads, while in other countries, the increase in the policy responses lags the growth in new cases.

Our dependent variable is the stock price of airline companies. We collect dividend-adjusted stock prices in 2020 from Refinitiv Eikon Datastream for SIC code 4512 (travel and leisure sector). Initial data include 87 active listed firms from 44 countries. Eight firms with incomplete firm-specific information are removed. In addition, we exclude six inactive firms. The final sample consists of 73 listed firms in 36 countries with 3334 firm-week observations. About one-third of the total airlines are from The US, China, and South Korea, with 10, 8, and 6 listed airlines, respectively. Weekly stock returns are computed using the stock prices on the week's last trading day. We use corporate financial data for 2019 from Worldscope, where all financial items are measured in USD. Further, our firm-specific variables include *SIZE*, *CASH*, *ROA*, and *LEV* as defined in Appendix A2. We select them as they are considered important and significant in previous studies (Ding et al., 2021; Martins & Cró, 2022; Ramelli & Wagner, 2020). For instance, large businesses diversify their operations more effectively and are less likely to declare bankruptcy. Firm leverage (*LEV*) tends to affect stock performance during economic downturns. We also add *DES,* a number of

destination countries, as more destinations can help airlines diversify their business risk. We use panel data estimation techniques with country and weekly fixed effects to examine the influence of government policy response indices on airline weekly stock returns. Our independent variables are COVID-19 and policy responses.

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\begin{aligned}
Return_{i,c,t} = {} & \alpha + \gamma_1 COVID_{c,t} + \gamma_2 PRI_{c,t-1} + \gamma_3 PRI_{c,t-1} \times COVID_{c,t} \\
& + \beta_1 SIZE_{i,c,2019} \times COVID_{c,t} + \beta_2 CASH_{i,c,2019} \times COVID_{c,t} \\
& + \beta_3 ROA_{i,c,2019} \times COVID_{c,t} + \beta_4 LEV_{i,c,2019} \times COVID_{c,t} \\
& + \beta_5 DES_{i,c,2019} \times COVID_{c,t} + \delta_i + \delta_t + e_{i,t},
\end{aligned}
\tag{2}
$$

where i, c, and t represent the firm, country, and week, respectively. $Return_{i,t}$ is the weekly stock return of firm i during week t. $COVID_{c,t}$ is the growth rate in the cumulative number of confirmed cases in country c during week t. $PRI_{c,t-1}$ is the policy response indicator in country c during week t-1. There are four types of PRI as explained earlier. We include the interactions between pre-pandemic firm-specific variables in 2019 and $COVID_{c,t}$. Our firm-specific variable δ_i is the firm fixed effect, and δ_t is the time fixed effect. As the unobserved effects (δ_i) and independent variables may be correlated, we use fixed effects instead of random effects. We confirm our hypothesis by performing the Hausman test. The later test result in Table 3 suggests that the fixed effect model is more appropriate than the random effect model.

As endogeneity being potentially driven by reverse causality, omitted variables, and measurement errors is of major concern in panel data analysis, there are three common methods in finance and economic literature to address this issue, namely instrumental variable, difference-in-difference, and exogenous shock. In this paper, we select an impact of exogenous shock for endogeneity check for the following reasons. As this paper focuses on the government response during the COVID-19 event, it is logical to investigate the impact of this unique event in world history and assumed to be an unanticipated impactful event. This is consistent with the study of Albuquerque et al. (2020), by using the event of the COVID-19 pandemic as an exogenous factor in the panel analysis. In addition, variables of interest in this paper, as presented in equation (2), are in lag values, controlling a possibility of reverse causality. The panel regression with fixed effect considers both observable and unobservable time-invariant factors, alleviating a problem of omitted variables. Even though a problem of measurement error of variable is least mentioned in prior studies of panel analysis, we also address it by employing several policy responses to the COVID-19 pandemic, in which most policies play a role in determining stock returns as shown in section 4, promising a less error in measuring government policy. This aligns with the study of Narayan et al. (2021) by using different sources for government interventions. In sum, our proposed models are not subject to endogeneity and model misspecification.

Table 1 presents the descriptive statistics of the variables of interest. Panel A reports airline negative stock returns in 2020, that is, −0.33% weekly and −17.16% annual returns. Moreover, the stocks of European airlines perform the worst (−1.15% weekly returns) compared to those of North American and Asian airlines (−0.1% weekly returns). Panel B shows the mean of COVID as 0.2353, implying that the number of COVID-19 confirmed cases increased weekly by 23.53%. Additionally, North America exhibits the highest infection growth rates (30.82%), followed by Europe (27.17%) and Asia (19.92%). The average GRI in Panel C is 53.97, with SI having the highest average score (56.53) and ESI the lowest (51.32). This implies that governments tend to implement stronger stringency policies rather than economic support policies to combat the COVID-19 pandemic.

Table 2 presents the correlation matrix and the variance inflating factor (VIF) results. Weekly returns are negatively correlated with the growth of confirmed cases, indicating the negative effect of the pandemic on airline stock returns. Stock returns positively correlate with all government response indices, suggesting that all policies may improve stock returns. Finally, all variables show VIF values between 1.04 and 1.55 which are lower than 5, which is a critical level. This test result implies that each variable has strong independence and cannot be predicted by other independent variables in the dataset.

4. Empirical results

Table 3 reports the results of Equation (2), the baseline results, with each column presenting the effects of different policy response indexes. In Column 1, the COVID-19 pandemic negatively impacts airline stock returns, as the coefficient is −0.0708. The coefficient of lagged GRI as 0.0007 at the 1% significance level, implying that airline stock returns increase by 21% from the mean one week after the GRI increases by one point. Then, we consider the policy sub-types by presenting CHI and ESI in Column 2 and SI and ESI in Column 3. We do not include CHI and SI in the same model because SI is a subset of CHI. The CHI and SI have a similar effect as GRI on airline stock returns, but ESI does not have a significant impact. These findings imply that only containment and health, and stringency policies impact the stock returns of airlines, and economic support policies do not influence the returns. In Column 2, the interaction between COVID and CHI is positive and statistically significant, signifying that containment and health policies alleviate the adverse impact of COVID-19 on airline stock returns. This result confirms that markets take social distancing and testing policy positively because of its effectiveness in reducing the number of COVID-19 confirmed cases.

On the contrary, the interaction between COVID and ESI is negative and statistically significant, indicating that economic support policies strengthen the negative impact of COVID-19 on airline stock returns. This finding suggests that investors take income support and debt relief negatively because it increases the number of COVID-19 confirmed cases. We postulate that as people receive monetary supports from government, they tend to be less protective of the pandemic, leading to higher growth in confirmed cases and strengthening the negative impact of stock returns. Column 3 of Table 3 uses SI instead of CHI and gets similar results as in Column 2.

Further, among the control variables of all columns, only firm size and the number of destination countries are significantly positive during the pandemic period. This supports the diversification and "too big to fail" argument. That is, large airlines tend to recover faster from crises than small airlines do. The results of the Hausman test presented in Table 3 validate the appropriateness of the fixed effects model.

Then, we consider whether airline ownership structures moderate the effect of government policies on their stock returns. To do so, we divide the sample into state-owned firms (SOEs) and non-state-owned firms (non-SOEs). Notably, SOEs are firms in which the government owns at least 25% ownership.[2] Columns 1–3 in Table 4 present the results of SOEs, and Columns 4–6 are the results of non-SOEs. Non-SOEs face the less negative impact of COVID-19 than SOEs. This can be because SOEs are less efficient, less profitable, and have weak corporate governance (Carney & Dostaler, 2006; Oum et al., 2004; Vo, 2016).[3] The effect of the policies is consistent with the baseline results. They boost airline stock returns, but the results are not significantly different for SOEs and non-SOEs. The interactions between COVID and the policy response index are statistically significant for non-SOEs in the same manner as results in Table 3. Therefore, we conclude that airline ownership structure affects the efficacy of containment and health policies through the reduction of confirmed cases.

Next, we analyze airline business operations. Columns 1–3 in Table 5 report the results of FSCs, and Columns 4–6 are the results of LCCs. Both FSCs and LCCs are adversely affected by the pandemic and are statistically insignificantly different. Moreover, all government policies, except economic support policies, can raise the stock returns of FSCs and LCCs. However, their effect is not statistically significantly different. The interactions between COVID and the policy response index are statistically

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[2] We also use 20% and 30% as thresholds. The results remain the same.

[3] Paired t-tests show a significance level of 5% at least.

Table 1
Descriptive statistics.

Variable	N	Mean	SD	P25	P50	P75
Panel A: Weekly stock return						
Full sample	3334	−0.0033	0.0804	−0.0485	−0.0038	0.0399
Ownership						
SOE	455	−0.0073	0.0825	−0.0537	−0.0071	0.0376
Non-SOE	2879	−0.0027	0.08	−0.0477	−0.0036	0.0402
Business types						
Full service	2146	−0.0036	0.0768	−0.0448	−0.0038	0.0371
Low cost	1188	−0.0028	0.0864	−0.0574	−0.0036	0.0487
Regions						
U.S. and Canada	506	−0.0013	0.0959	−0.0648	−0.0013	0.0636
Europe	546	−0.0115	0.0937	−0.0754	−0.0144	0.0535
Asia-Pacific	1872	−0.0014	0.0701	−0.0396	−0.0026	0.0344
Panel B: COVID						
Full sample	3334	0.2353	0.4085	0.0151	0.0597	0.200
Ownership						
SOE	455	0.2538	0.4209	0.0169	0.0662	0.2446
Non-SOE	2879	0.2324	0.4065	0.0144	0.0589	0.1964
Business types						
Full service	2146	0.2272	0.4024	0.0111	0.0532	0.1959
Low cost	1188	0.2501	0.4191	0.0233	0.0677	0.2127
Region						
U.S. and Canada	506	0.3082	0.4675	0.0654	0.0999	0.2068
Europe	546	0.2717	0.4437	0.0237	0.0771	0.2032
Asia-Pacific	1872	0.1992	0.3754	0.0077	0.0336	0.1672
Panel C: Policy response						
GRI	3334	53.9683	18.3579	47.78	59.44	66.11
CHI	3334	54.3753	18.6699	46.79	58.97	66.67
SI	3334	56.5295	22.5056	44.44	62.5	72.69
ESI	3334	51.3235	32.3326	37.50	50.00	75.00
Panel D: Firm specific						
SIZE	3334	11.1885	2.4672	9.4583	10.7775	12.5697
CASH	3334	0.4083	0.1731	0.286	0.4097	0.5338
LEV	3334	1.2543	5.327	0.6357	1.4754	2.2675
DESTINATION	3334	24.6026	17.3904	11	21	34
ROA	3334	0.0377	0.052	0.0027	0.0441	0.0812

This table reports the descriptive statistics of the variables of interest. Panel A presents the descriptive statistics of weekly returns of stocks in the airline industry, Panel B reports the statistics of weekly growth rate of the number of confirmed case of COVID-19. Both panels are also categorized by ownership, business types, and regions. Panel C presents various policy response indices. Panel D provides the statistics of firm characteristics. The sample data cover the period 2020 and the firm characteristics data are in 2019.

significant for LCCs in the same manner as the results in Table 3. Thus, we conclude that airline business operations influence the impact of containment and health policies through the reduction in confirmed cases and economic support policies through the increase in confirmed cases.

Finally, we divide our sample by region: North America, Europe, and Asia. Columns 1–3 show the results of airlines headquartered in North America, Columns 4–6 are the results of those headquartered in Europe, and Columns 7–9 are the results of those in Asia. The impact of the pandemic is negative and statistically significant on the stock returns of airlines headquartered in North America and Asia but not Europe. Moreover, the GRI, CHI, and SI policies are effective in Europe and Asia but not in North America. However, ESI is ineffective in raising airline stock returns. Interestingly, the SI plays a moderating role only in the United States and Canada.

We find a statistically insignificant effect of COVID-19 on stock returns in Europe. The magnitude of the impact, however, is harmful. A possible explanation is that investors believe that European governments would be lenders or investors of last resort to support airlines is in line with Abate et al. (2020). Thus, this may help lessen investors' fear and panic. Another possible explanation is that European airlines communicate better with their stakeholders during COVID-19 than others. This is supported by Scheiwiller and Zizka (2021), who suggest that crisis communication strategies are essential for airline stakeholders moving forward.

To summarize, the COVID-19 pandemic harms airline stock returns,

but government policy responses can raise these returns. Only containment and health, and stringency policies effectively increase returns, not economic support policies. Moreover, the efficacy of policy responses differ significantly based on airline ownership structures, business operations, and headquarters.

5. Discussion and implications

First, the results of this study show that the overall government policies response to COVID-19 can raise airline stock returns that is consistent with the findings of Chang et al. (2021). This findings also contribute to the on going debate on whether government policy responses benefit the economy, businesses, and production (Shanaev et al., 2020). Moreover, we further investigate the effectiveness of each policy category.

The findings report that only the CHI and SI positively affect airline stock returns that are coherent with (Chang et al., 2021). This reinforces the government's crucial role in enforcing stricter containment measures, investing more in health systems and COVID-19 vaccines, and tightening coronavirus control measures. A strong CHI helps control the spread of COVID-19, increasing investors' confidence. Thus, good healthcare systems help identify new cases and reduce virus transmission. They also help the economy and business recover more rapidly. Furthermore, the interaction terms (CHI * COVID) and (SI * COVID) show significant and positive impacts on the returns. The moderating effects suggest that the CHI and SI mitigate the pandemic-induced

Table 2
Correlation matrix.

	RETURN	COVID	GRI	CHI	SI	ESI	SIZE	CASH	ROA	LEV	DES	VIF	Tolerance
RETURN	1.0000												
COVID	-0.1937***	1.0000										1.24	0.8095
GRI	0.2293***	-0.3140***	1.0000									1.13	0.8846
CHI	0.2135***	-0.2504***	0.9767***	1.0000								1.30	0.7709
SI	0.1957***	-0.1493***	0.9395***	0.9675***	1.0000							1.23	0.8134
ESI	0.1749***	-0.3973***	0.5926***	0.4059***	0.3695***	1.0000						1.55	0.6445
SIZE	0.0011	-0.0387**	-0.0463***	-0.0033	-0.0378**	-0.1851***	1.0000					1.24	0.8090
CASH	0.0149	0.0335**	-0.0811***	-0.1252***	-0.1052***	0.1244***	-0.2855***	1.0000				1.22	0.8205
ROA	0.0273*	0.0207	0.0234	0.0389*	0.0599***	-0.0462***	-0.2923***	0.2740***	1.0000			1.22	0.8224
LEV	-0.0058	-0.0437***	-0.0584***	-0.0650***	-0.0776***	-0.005	0.1026***	0.0537***	-0.0085	1.0000		1.08	0.9292
DES	-0.0230	0.0504***	0.0181	-0.0114	0.0064	0.1196***	0.0187	-0.0636***	0.0847***	-0.1155***	1.0000	1.04	0.9610

This table reports the results of the correlation matrix. Appendix A2 provide details on variable definitions. The variance inflating factor (VIF) is also reported with tolerance equals the reciprocal of VIF. The *t*-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels.

Table 3
Baseline results.

	Weekly stock return		
	(1)	(2)	(3)
COVID	-0.0708***	-0.0753***	-0.0745***
	(-3.608)	(-3.817)	(-3.849)
GRI (t-1)	0.0007***		
	(4.748)		
GRI (t-1) * COVID	0.0001		
	(0.714)		
CHI (t-1)		0.0006***	
		(4.596)	
CHI (t-1) * COVID		0.0004*	
		(1.723)	
SI (t-1)			0.0005***
			(4.805)
SI (t-1) * COVID			0.0003*
			(1.903)
ESI (t-1)		<0.0000	<0.0000
		(0.0813)	(0.138)
ESI (t-1) * COVID		-0.0004**	-0.0004**
		(-2.037)	(-2.220)
SIZE * COVID	0.0030**	0.0027*	0.0026*
	(2.162)	(1.934)	(1.894)
CASH * COVID	0.0289	0.0409	0.0456*
	(1.087)	(1.483)	(1.663)
ROA * COVID	-0.0357	-0.0466	-0.0435
	(-0.560)	(-0.725)	(-0.675)
LEV * COVID	0.0006	0.0006	0.0006
	(1.093)	(1.115)	(1.100)
DES * COVID	0.0003*	0.0003**	0.0003**
	(1.769)	(1.993)	(1.978)
Constant	0.0357***	0.0364***	0.0404***
	(3.060)	(3.100)	(3.516)
Country FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Observations	3334	3334	3334
Hausman test	2702.87***	1572.22***	786.32***
Adjusted R-squared	0.408	0.411	0.411

Table 3 presents panel regressions with fixed effects for a relationship between the growth in the number of confirmed cases and stock market performance of the global airline industry. $Return_{i,t}$ is the weekly stock return of firm i at week t. $COVID_{c,t}$ is the growth rate of the cumulative number of confirmed cases in a country c in week t. GRI, CHI, SI, and ESI are at time t-1. We also include interactions between pre-pandemic firm-specific variables in 2019 and COVID. Appendix A2 provide details on variable definitions. The regression covers 48-week data of COVID-19 with 3334 firm-week observations. The t-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels.

negative impact on airline stock returns. Thus, the tightened CHI and SI are crucial in building investors' confidence. This findings are consistent with Capelle-Blancard and Desroziers (2020). In other words, investors perceive lockdowns as a solution for controlling the spread of the virus. Sun et al. (2021) document that air transportation restrictions could prevent the initial spread of COVID-19. These findings are similar to those of Meng et al. (2021), who investigate the short-term impact of different COVID-19 control policies on air transportation. They document that travel restrictions in China have been strictly implemented, allowing air travel to recover quickly. This implies that stricter restrictions tend to support stock returns, aligning with Phan and Narayan's (2020) findings.

Surprisingly, stimulus packages do not have any effect on airline stock returns. This finding corresponds with Zaremba et al.'s (2021) findings but contrast to the findings of Phan and Narayan (2020). Their results show that the stock market reacted positively when countries announced their stimulus packages; however, the countries that successfully implemented the packages had already deployed travel bans

Table 4
State-own companies.

| | Weekly stock return | | | | | |
| | SOE | | | Non-SOE | | |
	(1)	(2)	(3)	(4)	(5)	(6)
COVID	−0.270***	−0.299***	−0.304***	−0.0599***	−0.0642***	−0.0637***
	(-3.251)	(-3.434)	(-3.550)	(-2.856)	(-3.042)	(-3.095)
GRI (t-1)	0.0006			0.0006***		
	(1.378)			(4.446)		
GRI (t-1) * COVID	<0.0000			0.0002		
	(-0.038)			(0.951)		
CHI (t-1)		0.0009**			0.0006***	
		(2.085)			(4.005)	
CHI (t-1) * COVID		−0.0002			0.0004*	
		(-0.307)			(1.881)	
SI (t-1)			0.0006*			0.0005***
			(1.916)			(4.286)
SI (t-1) * COVID			<0.0000			0.0004**
			(-0.156)			(1.997)
ESI (t-1)		−0.0004	−0.0003		<0.0000	<0.0000
		(-1.289)	(-1.218)		(0.558)	(0.556)
ESI (t-1) * COVID		0.0002	0.0002		−0.0004*	−0.0004**
		(0.450)	(0.321)		(-1.910)	(-2.061)
SIZE * COVID	0.0157***	0.0176***	0.0177***	0.0017	0.0015	0.0015
	(2.913)	(3.142)	(3.109)	(1.183)	(0.983)	(1.010)
CASH * COVID	0.4490**	0.4810**	0.5260***	0.0233	0.0357	0.0383
	(2.376)	(2.467)	(2.673)	(0.886)	(1.312)	(1.417)
ROA * COVID	−0.244	−0.231	−0.220-	−0.0529	−0.0700	−0.0678
	(-1.087)	(-1.036)	(-0.980)	(-0.776)	(-1.021)	(-0.984)
LEV * COVID	−0.0008	−0.0013	−0.0014	0.0009	0.0010	0.0009
	(-0.540)	(-0.814)	(-0.927)	(1.331)	(1.411)	(1.357)
DES * COVID	0.0007*	0.0009*	0.0008*	0.0003	0.0003*	0.0003*
	(1.774)	(1.769)	(1.649)	(1.390)	(1.681)	(1.681)
Constant	0.0015	0.0068	0.0036	0.0402***	0.0407***	0.0442***
	(0.0528)	(0.253)	(0.132)	(3.340)	(3.344)	(3.726)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	455	455	455	2879	2879	2879
Adjusted R-squared	0.303	0.306	0.305	0.429	0.430	0.431

Table 4 presents panel regressions with fixed effects for a relationship between the growth in the number of confirmed cases and stock market performance of the global airline industry between SOEs and non-SOEs. $Return_{i,t}$ is the weekly stock return of firm i at week t. $COVID_{c,t}$ is the growth rate of the cumulative number of confirmed cases in a country c in week t. GRI, CHI, SI, and ESI are at time t-1. We also include interactions between pre-pandemic firm-specific variables in 2019 and COVID. Appendix A2 provide details on variable definitions. The regression covers 48-week data of COVID-19 with 3334 firm-week observations. The t-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels.

and lockdowns. The sequence of policy adoption may be necessary. The possibe explanation why stimulus packages did not impact airline returns can be that they were not adequately tailored to the airline industry. Therefore, we call on governments and policymakers to establish accommodative policies (such as soft loans, financial aid, equity purchases, and tax referrals or reductions) to support airline companies and provide adequately sized stimulus packages to combat such adverse shocks.

Governments need to initiate better responses to pandemics in the future to stabilize the airline industry and quickly build market participants' confidence and trust. They must understand that coronavirus-related policy responses significantly influence the trading environment in stock markets. This is because higher trading activity substantially contributes to a lower cost of equity capital (Zaremba et al., 2021).

Second, the findings direct us toward discussing international coordination among governments. It becomes challenging to resume international flights if COVID-19 persists in other countries. Nations should coordinate with others to secure vaccines because vaccine-related policies are crucial for airline service resumption and recovery. Moreover, vaccination is essential to stabilize airline operations and build investor confidence. We also provide helpful pointers for political leaders wanting to evaluate their country's weaknesses in combating the pandemic. Similar to Zaremba et al. (2021), we suggest that vaccines are

distributed globally, and their availability to citizens worldwide be ensured. This will stabilize airline businesses in all regions. Moreover, a globally orchestrated response to COVID-19 is needed (Budd et al., 2020; Sun et al., 2021).

Governments, international organizations, airlines, airport operators, and regulatory bodies must cooperate in establishing new protocols to increase demand in the airline industry in the face of COVID-19. For instance, passenger screening measures or "Vaccine Passports" may help protect travelers and staff. Moreover, new protocols related to biosecurity and passenger screening affected both passengers and airlines in terms of time and cost. This may involve travel demand. A roadmap for resuming airline operations must be created, emphasizing airline financial resiliency.

We encourage the relevant organizations to communicate such guidelines to all parties, including investors. Valuable and transparent information can increase investors' confidence and protect them from shocks. Consequently, investors may expect airlines to resume operations shortly when international cooperation sets up global standards for vaccination and testing (IATA, 2021). Kim and Sohn (2021) state that non-financial measures are needed to combat the pandemic while securing the interests of the airline industry. These may include establishing quarantine-free travel corridors between countries with similar confirmed cases and providing transparent information to restore

Table 5
Business types.

| | Weekly stock return | | | | | |
| | Full service | | | Low cost | | |
	(1)	(2)	(3)	(4)	(5)	(6)
COVID	−0.0729***	−0.0761***	−0.0767***	−0.107**	−0.111**	−0.101**
	(-2.797)	(-2.884)	(-3.007)	(-2.279)	(-2.350)	(-2.154)
GRI (t-1)	0.0006***			0.0007**		
	(3.759)			(2.415)		
GRI (t-1) * COVID	0.0002			0.0003		
	(0.554)			(0.764)		
CHI (t-1)		0.0006***			0.0005*	
		(3.823)			(1.871)	
CHI (t-1) * COVID		0.0003			0.0007**	
		(0.954)			(2.164)	
SI (t-1)			0.0005***			0.0004**
			(3.840)			(2.241)
SI (t-1) * COVID			0.0002			0.0006**
			(1.098)			(2.159)
ESI (t-1)v		<0.0000	<0.0000		0.0001	0.0001
		(-0.249)	(-0.193)		(0.644)	(0.690)
ESI (t-1) * COVID		−0.0003	−0.0003		−0.0007**	−0.0008**
		(-1.052)	(-1.063)		(-2.123)	(-2.400)
SIZE * COVID	0.0029*	0.0027	0.0028	0.0052	0.0041	0.0037
	(1.693)	(1.595)	(1.616)	(1.558)	(1.209)	(1.072)
CASH * COVID	0.0690	0.0773	0.0798	0.0115	0.0279	0.0335
	(1.080)	(1.176)	(1.227)	(0.339)	(0.792)	(0.961)
ROA * COVID	−0.104	−0.106	−0.1000	0.0267	−0.0173	−0.0230
	(-1.183)	(-1.176)	(-1.115)	(0.250)	(-0.162)	(-0.214)
LEV * COVID	0.0004	0.0004	0.0004	0.0018	0.0017	0.0016
	(0.662)	(0.666)	(0.656)	(0.843)	(0.764)	(0.715)
DES * COVID	0.0003	0.0003	0.0003	0.0007	0.0008*	0.0008*
	(1.454)	(1.591)	(1.566)	(1.435)	(1.807)	(1.766)
Constant	0.0336**	0.0335**	0.0379***	0.0389**	0.0420**	0.0428**
	(2.479)	(2.476)	(2.878)	(1.995)	(1.975)	(2.116)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2146	2146	2146	1188	1188	1188
Adjusted R-squared	0.385	0.386	0.386	0.442	0.447	0.448

Table 5 presents panel regressions with fixed effects for a relationship between the growth in the number of confirmed cases and stock market performance of the global airline industry between full service and low cost airlines. $Return_{i,t}$ is the weekly stock return of firm i at week t. $COVID_{c,t}$ is the growth rate of the cumulative number of confirmed cases in a country c in week t. GRI, CHI, SI, and ESI are at time t-1. We also include interactions between pre-pandemic firm-specific variables in 2019 and COVID. Appendix A2 provide details on variable definitions. The regression covers 48-week data of COVID-19 with 3334 firm-week observations. The t-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels.

international passengers' demand. Policymakers should evaluate the impact of different policy responses on airline financial performance, as ignoring their impact may create more issues, such as layoffs.

Third, the results imply that investors should diversify their risks by selectively investing in non-SOEs, European airlines, large airline companies, and airlines with numerous destination countries.These airlines have less advese impact of COVID-19. Our study also complements the infrastructure and portfolio rebalancing channels (Zaremba et al., 2020) and market risk premium channels (Aggarwal et al., 2021). When workplace closures create uncertainty of airlines' performance including earnings and cash flows, investors may rebalance their portfolios to conform with their risk and reward profile.

Fourth, non-SOE airlines are less affected by rising COVID-19 confirmed cases than SOEs. This is a crucial insight for airline managers and supports Oum, Park, Kim, and Yu's (2004) findings. Autonomous public corporations majorly controlled by private firms perform better than government-controlled firms do because non-SOEs may have more institutional investors who process information faster than SOEs do. They may also communicate better with their investors. Our findings align with those of Carney and Dostaler (2006) reporting that non-SOEs have better mechanisms to protect their firm value from mismanagement. Interestingly, only non-SOEs positively react to GRI, implying that the governments' policy responses and support help only non-SOEs.

The findings regarding our control variables, particularly asset size

and number of foreign destination countries, show a "too big to fail" phenomenon in the airline industry. Larger airlines seem to recover quicker than smaller airlines do, and airlines with many destination countries have more market options for resumption and diversification of their operational risks once restrictions are relaxed. Additionally, larger airlines tend to have more bargaining power when applying for governmental financial support. Partial or total nationalization is a potential government relief measure (OECD, 2020). It depends on how large companies pursue the government regarding buying some shares to avoid takeovers or bankruptcy. Additionally, market power and productive efficiency relate to the shareholder's valuation gain of a merger (Ho et al., 2020). Alternatively, if airlines choose to increase their asset size via mergers and acquisitions (M&As), the government should design a regulatory framework for M&As to protect the airline industry from being monopoly.

6. Conclusion

The government interventions for COVID-19, such as lockdowns and travel bans, have significantly damaged the airline industry. However, the impact of government interventions on airline stock returns remains unexplored. This study fills the gap by investigating the effect of COVID-19 governments responses on the weekly stock returns of airline companies worldwide.

Table 6
Regions.

	Weekly stock return								
	US and Canada			Europe			Asia-Pacific		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
COVID	−0.1420*	−0.2020**	−0.1820**	−0.1370	−0.1370	−0.1330	−0.0626**	−0.0636**	−0.0702**
	(-1.883)	(-2.507)	(-2.246)	(-0.925)	(-0.902)	(-0.879)	(-2.057)	(-2.091)	(-2.380)
GRI (*t*-1)	−0.0006			0.0008*			0.0006***		
	(-0.157)			(1.835)			(3.604)		
GRI (*t*-1) * COVID	0.0017			0.0005			<0.0000		
	(0.705)			(0.786)			(0.194)		
CHI (*t*-1)		−0.0001			0.0008			0.0006***	
		(-0.0414)			(1.578)			(3.648)	
CHI (*t*-1) * COVID		0.0030			0.0003			<0.0000	
		(1.261)			(0.445)			(0.0079)	
SI (*t*-1)			−0.0016			0.0006			0.0005***
			(-0.738)			(1.626)			(4.055)
SI (*t*-1) * COVID			0.0028*			0.0002			<0.0000
			(1.769)			(0.377)			(0.368)
ESI (*t*-1)		−0.0004	−0.0001		<0.0000	<0.0000		<0.0000	<0.0000
		(-0.268)	(-0.0779)		(0.306)	(0.305)		(0.0677)	(0.114)
ESI (*t*-1) * COVID		<0.0000	−0.0001		0.0002	0.0002		<0.0000	<0.0000
		(0.0477)	(-0.135)		(0.434)	(0.395)		(0.333)	(0.088)
SIZE * COVID	0.0002	0.0012	0.0015	0.0107	0.0106	0.0106	0.0027	0.0029	0.0031
	(0.033)	(0.181)	(0.221)	(0.903)	(0.889)	(0.892)	(1.348)	(1.423)	(1.532)
CASH * COVID	0.1000	0.1370	0.1470	−0.0014	−0.0016	0.0136	0.0111	0.0104	0.0132
	(1.013)	(1.013)	(1.075)	(-0.011)	(-0.013)	(0.107)	(0.291)	(0.274)	(0.348)
ROA * COVID	0.4900*	0.4750*	0.4710*	0.4370	0.4290	0.3820	−0.0231	−0.0167	−0.0207
	(1.848)	(1.770)	(1.742)	(0.717)	(0.718)	(0.645)	(-0.265)	(-0.189)	(-0.234)
LEV * COVID	−0.0009	−0.0008	−0.0008	0.0022	0.0020	0.0019	0.0007	0.0007	0.0007
	(-1.032)	(-0.975)	(-0.945)	(0.757)	(0.745)	(0.699)	(0.810)	(0.772)	(0.759)
DES * COVID	<0.0000	<0.0000	<0.0000	−0.0002	−0.0001	<0.0000	0.0006**	0.0006*	0.0006*
	(0.295)	(0.415)	(0.448)	(-0.210)	(-0.137)	(-0.074)	(2.004)	(1.908)	(1.870)
Constant	0.0812*	0.111**	0.0971**	0.0815***	0.0812***	0.0783***	−0.0071	−0.0101	−0.0055
	(1.807)	(2.471)	(1.981)	(3.226)	(3.247)	(3.188)	(-0.504)	(-0.695)	(-0.393)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	506	506	506	546	546	546	1872	1872	1872
Adjusted R-squared	0.860	0.860	0.860	0.452	0.450	0.450	0.381	0.380	0.382

Table 6 presents panel regressions with fixed effects for a relationship between the growth in the number of confirmed cases and stock market performance of the global airline industry among three regions. $Return_{i,t}$ is the weekly stock return of firm i at week t. $COVID_{c,t}$ is the growth rate of the cumulative number of confirmed cases in a country c in week t. GRI, CHI, SI, and ESI are at time t-1. We also include interactions between pre-pandemic firm-specific variables in 2019 and COVID. Appendix A2 provide details on variable definitions. The regression covers 48-week data of COVID-19 with 3334 firm-week observations. The t-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels.

We find that a rising number of confirmed COVID-19 cases worsens the weekly airline stock returns. The government's overall policy responses increase stock returns but do not alleviate the negative impact of growth in COVID-19 confirmed cases. Containment and health and stringency policies increase stock returns and mitigate the negative effect of COVID-19 on airline stock returns. These restrictive policies build investor confidence in controlling the spread of COVID-19 through strict measures. Consequently, investors expect that airlines may be able to resume their operations shortly. Economic support policies also increase stock returns but strengthen the negative impact of the pandemic on stock returns.

This study contributes to the ongoing debate on whether government policy responses to COVID-19 are economically beneficial. Our analysis also discusses the importance of supportive and tailored policies and stimulus packages because the airline industry requires adequate liquidity. Declining in stock prices can limit the ability of airlines to access external fund or favorable credit terms. Therefore, airlines must be rescued so they can resume operations quickly. Pre-pandemic firm conditions, such as asset size and the number of destination countries, mitigate stock price drops and suggest the existence of a "too big to fail" phenomenon in the airline industry.

In conclusion, governments should assess the impact of policy implementation and balance citizens' health concerns and the country's economic conditions. Therefore, we suggest policymakers involving the

current pandemic and planning for such future crises that they can use our findings to assess the effects of different government policy responses. Furthermore, international organizations related to the aviation industry should not hesitate to support governments' pandemic-fighting policies. Lastly, boosting investor confidence and airline financial resilience is essential for sustainable airline businesses.

This study has some limitations and leave rooms for future research. Future studies can use different variables, such as death numbers, to proxy the severity of COVID-19. In addition, the role of institutional ownership and other factors may explain airline stock returns during a pandemic crisis. Finally, researchers may evaluate the economic costs of policy responses. This is a worthwhile avenue for future research.

CRediT authorship contribution statement

Suntichai Kotcharin: Conceptualization, design of study, Data curation, Formal analysis, Writing – original draft, Writing – review & editing, critically for important intellectual content, approval of the version of the manuscript to be published. **Sakkakom Maneenop:** Conceptualization, and design of study, Data curation, Formal analysis, Writing – original draft, Writing – review & editing, critically for important intellectual content, approval of the version of the manuscript to be published. **Anutchanat Jaroenjitrkam:** Conceptualization, design of study, Data curation, Formal analysis, Writing – original draft,

Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A1. Company list

Stock Name	Country	Stock Name	Country
QANTAS AIRWAYS	Australia	PAL HOLDINGS	Philippines
REGIONAL EXPRESS HDG.	Australia	AEROFLOT RUSS.AIRL.	Russia
AIR CANADA VOTING AND VARIABLE VOTING	Canada	SINGAPORE AIRLINES	Singapore
LATAM AIRLINES GROUP	Chile	KOREAN AIR LINES	South Korea
CHINA EXPRESS AIRLINES 'A'	China	ASIANA AIRLINES	South Korea
SHANDONG AIRL.'B'	China	JEJUAIR	South Korea
CHINA SOUTHERN AIRLINES 'A'	China	TWAY AIR	South Korea
CHINA EASTERN AIRL. 'A'	China	JIN AIR	South Korea
HAINAN AIRLINES HDG.'A'	China	AIR BUSAN	South Korea
SPRING AIRLINES 'A'	China	SAS	Sweden
AIR CHINA LIMITED 'A'	China	CHINA AIRLINES	Taiwan
JUNEYAO AIRL.'A'	China	EVA AIRWAYS	Taiwan
AVIANCA HDG.SPON AMER. DPREC.1:8	Colombia	TIGERAIR TAIWAN	Taiwan
FINNAIR	Finland	ASIA AVIATION	Thailand
AIR FRANCE-KLM	France	BANGKOK AIRWAY	Thailand
DEUTSCHE LUFTHANSA (XET)	Germany	NOK AIRLINES	Thailand
AEGEAN AIRLINES CR	Greece	THAI AIRWAYS INTL.	Thailand
CATHAY PACIFIC AIRWAYS	Hong Kong	TUNIS AIR	Tunisia
ICELANDAIR GROUP	Iceland	PEGASUS HAVA TASIMACILIGI A LTD.	Turkey
INTERGLOBE AVIATION	India	TURK HAVA YOLLARI	Turkey
SPICEJET	India	AIR ARABIA	United Arab Emirates
GARUDA INDONESIA (PERSERO)	Indonesia	EASYJET	United Kingdom
RYANAIR HOLDINGS	Ireland	JET2	United Kingdom
EL AL	Israel	WIZZ AIR HOLDINGS	United Kingdom
JAPAN AIRLINES	Japan	AMERICAN AIRLINES GROUP	United States
ANA HOLDINGS	Japan	ALASKA AIR GROUP	United States
STAR FLYER	Japan	ALLEGIANT TRAVEL	United States
KENYA AIRWAYS	Kenya	COPA HOLDINGS S A	United States
JAZEERA AIRWAYS	Kuwait	DELTA AIR LINES	United States
AIRASIA GROUP	Malaysia	HAWAIIAN HOLDINGS	United States
AIRASIA X	Malaysia	JETBLUE AIRWAYS	United States
GRUPO AEROMEXICO	Mexico	SOUTHWEST AIRLINES	United States
CONTROLADORA VUELA COMPANIA DE AVIACION	Mexico	SPIRIT AIRLINES	United States
AIR NEW ZEALAND	New Zealand	UNITED AIRLINES HOLDINGS	United States
NORWEGIAN AIR SHUTTLE	Norway	VIETNAM AIRLINES	Vietnam
PAKISTAN INTERNATIONAL AIRLINES A	Pakistan	VIETJET AVIATION	Vietnam
CEBU AIR	Philippines		

Appendix A2. Definition of variables

Variable	Measurement	Source
Dependent variable		
Weekly stock return	The weekly stock return of each firm in a week is calculated by using dividend adjusted closing prices on the last trading day of the week.	Datastream
Independent variables		
COVID	$\ln(1+\#$cumulative cases in week t) – $\ln(1+\#$cumulative cases in week t-1), where cumulative Cases is the cumulative number of confirmed cases in economy c as of Friday in week t.	Center for Systems Science and Engineering at Johns Hopkins University (JHU CSSE)
GRI	Government Response Index. It is composed of the following indicators: school closing, workplace closing, cancel public events, restrictions on gathering size, close public transport, stay at home requirements, restrictions on internal movement, restrictions on international travel, public information campaign, testing policy, contact tracing, facial coverings, vaccination policy, protection of elderly people, income support, and debt relief for households. Hale et al. (2021) create a score by taking the ordinal value and rescale each of these by their maximum value to create a score between 0 and 100. These scores are then averaged to get the GRI index.	Oxford COVID-19 Government Response Tracker, Blavatnik School of Government, University of Oxford
CHI	Containment Health Index. It is composed of the following indicators: school closing, workplace closing, cancel public events, restrictions on gathering size, close public transport, stay at home requirements, restrictions on internal movement, restrictions on international travel, public	As above

(*continued*)

Variable	Measurement	Source
SI	information campaign, testing policy, contact tracing, facial coverings, vaccination policy, and protection of elderly people. The index calculation is done in the same manner as GRI. Stringency Index. It is composed of the following indicators: school closing, workplace closing, cancel public events, restrictions on gathering size, close public transport, stay at home requirements, restrictions on internal movement, restrictions on international travel, public information campaign. The index calculation is done in the same manner as GRI.	As above
ESI	Economic Supporting Index. It is calculated from income support, and debt relief for households indicators. The index calculation is done in the same manner as GRI.	As above
SIZE	The natural logarithm of the book value of total assets	Worldscope
CASH	The total amount of cash and short-term investments divided by total assets	Worldscope
LEV	The ratio of total debt divided by the book value of equity	Worldscope
ROA	Earnings before interest and taxes divided by total assets	Worldscope
DES	Number of destination countries	Flightradar24.com

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