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Sail Away to a Safe Harbor? COVID-19 Vaccinations and the Volatility of Travel and Leisure Companies

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Abstract: This paper examines the impact of vaccination programs on the stock market volatility of the travel and leisure sector. Using daily data from 56 countries over the period from January 2020 to March 2021, we find that vaccination leads to a decrease in the investment risk of travel and leisure companies. Vaccination results in a decrease in the volatility of stock prices of travel and leisure companies. The drop in volatility is robust to many alternative estimation techniques, different volatility measures, and various proxies for vaccinations. Moreover, this effect cannot be explained by an array of control variables; this includes the pandemic itself and both the containment and closure policies that followed. Furthermore, the beneficial role of vaccinations is relatively stronger in emerging markets than in developed ones.

Keywords: COVID-19; pandemic; stock market volatility; travel and leisure; vaccinations

JEL Classification: G01; G12; G15; G18; H12; H51; I18; Q54

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1. Introduction

The COVID-19 pandemic has had an unprecedented effect on not only humanity but also the global economy. Notably, the tourism and hospitality sectors—in particular—have been hit hardest by the pandemic (Gerwe 2021; Nagaj and Žuromskaitė 2021; World Economic Forum 2022). In 2021, international tourist arrivals remained 72% below 2019 levels, which equals more than 1 billion fewer arrivals. This implies that the industry reached levels last seen in the late 1980s (World Economic Forum 2022). Governments implement several policy measures in order to help flatten the curve due to the asymptomatic transmission of COVID-19. Border closures, travel restrictions, gathering size limitations, quarantines, and temporary closure of restaurants all have detrimental impacts on the hospitality and tourism industry. Although temporary reopening in the summer of 2020 was considered a partial solution, new lockdown measures that have been implemented due to new waves have, once again, brought tourism to a complete standstill. The World Travel and Tourism Council estimates that the global travel and tourism sector's contribution to global GDP experienced an unprecedented decline of nearly 50% in 2020.[1]

The tourism and hospitality literature shows a rising interest in analyzing the impact of COVID-19 on the industry. Early studies focus on the preliminary impact that COVID-19 has had on the tourism industry. They show that COVID-19 harms hospitality companies' performance (Anguera-Torrell et al. 2020; Gil-Alana and Poza 2020; Lee et al. 2021; Lin and Falk 2021; Wu et al. 2021) or tourism demand—in general (Gössling et al. 2020;

Yang et al. 2020). Another line of research explores what factors can provide resiliency to those companies. Chen et al. (2020), Kaczmarek et al. (2021), Jawed et al. (2021), Poretti and Heo (2021), and Song et al. (2021) show that the negative impact of COVID-19 is heterogeneous, as better pre-pandemic financial characteristics can provide immunity to hospitality firms against COVID-19. In a similar vein, Qiu et al. (2021) show that CSR activities can improve the stock returns of tourism firms during the COVID-19 pandemic. Recent studies explore the recovery of the tourism industry under different scenarios (Zhang et al. 2021; Fotiadis et al. 2021).

In this paper, we aim to explore whether mass vaccinations help to play a role in stabilizing financial markets. Specifically, we analyze the relationship between daily mass vaccinations and stock market volatility of travel and leisure companies. Mass vaccinations are expected to lower the stock price volatility of travel and leisure companies because herd immunity becomes a key concept for controlling the pandemic. An effective vaccine can be considered the safest way to reach herd immunity (Fontanet and Cauchemez 2020). Vaccination programs are essential for the tourism and hospitality industry. Mass vaccination can speed up the industry's recovery (Zhu et al. 2021), leading to an increase in the demand for hospitality and tourism services. Global availability of COVID-19 vaccines and the resulting herd immunity will lower the risk perceptions and travel anxiety, which can contribute to the recovery of the hospitality and tourism industry (Gursoy and Chi 2020). Investors can regard tourism stocks as a less risky and uncertain vehicle of investment since countries that are on track to achieve herd immunity utilizing vaccinations are contemplating the possibility of reopening their borders for both domestic and international travel. A mass vaccination program can eliminate the pandemic-induced volatility in financial markets via different channels.

The first channel is the decrease in macroeconomic uncertainty, which transmits to the tourism and hospitality industry. The rollout of vaccinations enables countries to control the COVID-19 pandemic. As countries approach herd immunity, businesses reopen, and social gathering and traveling restrictions are gradually relaxed. Government interventions—such as border closures and travel restrictions—can be minimized once herd immunity is achieved. The elimination of such unexpected interventions will also eliminate substantial negative demand and supply-side shocks (del Rio-Chanona et al. 2020), as vaccinated people might travel both domestically and internationally. The future cash flows of travel and leisure companies will be more predictable. As the industry recovers, economic expectations stabilize. A growing (declining) volume of good (bad) news increases (decreases), triggering volatility declines. This leads to a lower tourism and hospitality industry stock volatility. While there is evidence that the pandemic triggered an unprecedented increase in macroeconomic uncertainty (Altig et al. 2020; Baker et al. 2020; Caggiano et al. 2020; Sharif et al. 2020), our results, reported in Section 3, show that the reversal can have stabilizing effects on international stock markets. Thus, consistently with Bansal and Yaron (2004) and Bansal et al. (2014), volatility in the tourism and hospitality industry can be driven by macroeconomic expectations. Second, stock market volatility decreases because in countries where a larger population share becomes immunized, there is a lower probability of unexpected government interventions, which might otherwise disrupt the economy and the tourism and hospitality industry and/or undermine its recovery. As governments can more confidently ease or even terminate lockdowns, businesses operating in the tourism and hospitality industry and tourists become less dependent on government economic support packages, strengthening public finances and reducing the need to raise tax rates. This can lead to the repricing of financial assets, including stocks. Consistently with Mele (2007), volatility can change due to changing expectations of future returns in the tourism and hospitality industry. Third, vaccinations can lower the financial/operating leverage of firms, including tourism and hospitality operators (Schwert 1989), which manifests in improved financial performance and a decrease in financial risk. Fourth, vaccinations are associated with less stringent government restrictions. Concurrently, in line with Manela and Moreira (2017), decreases in the flow of policy-related news are associated with lower stock market volatility. Fifth, the divergence of opinions (Harris and Raviv 1993; Banerjee 2011; Foucault et al. 2011), driven by the COVID-19 pandemic crisis, becomes less significant when the economy and the tourism and hospitality industry is on course to achieve herd immunity. This is likely to calm stock market volatility too. Sixth, vaccinations can conceivably reduce fear in financial markets. In line with Donadelli et al. (2017), globally dangerous diseases can spread fear throughout the economy, which spills over to the stock market (through the so-called "Main Street" effects). Even if no traveling restrictions to the affected countries are in place, rational individuals will take preventive measures, and they would likely amend their travel plans. In this light, the rollout of vaccinations is likely to curb investor fear spread. All these elements should lead to greater price stability in financial markets. Expectations of improved performance in the tourism and hospitality industry can trigger less sizable valuation changes, which results in lower volatility.

To examine the role of vaccinations, we use daily data from 56 markets around the world from the period January 2020–March 2021. In particular, we explore the novel dataset of global vaccinations that—to our knowledge—has never been explored in the broad international context of tourism sector performance or in financial markets. We run a battery of panel regressions to determine how the vaccinations affect the risk and volatility of travel and leisure companies.

Our findings demonstrate that vaccination results in a decrease in the volatility of stock prices of travel and leisure companies. The drop in risk is both economically and statistically significant, pervasive, and robust to many considerations. It survives different measures of volatility and various proxies for vaccinations. It is not explained by an array of control variables; this includes the pandemic itself and both the containment and closure policies that followed. Finally, the beneficial role of vaccinations is relatively stronger in emerging markets than in developed ones.

To the best of our knowledge, we are the first to analyze the impact of vaccination on the stock market volatility of travel and leisure companies across 56 countries. Earlier studies in the related literature focus on the role of the pandemic itself or government policy responses. We consider the role of vaccination in controlling the impact of the pandemic itself and government interventions. We extend the discussion on how the financial markets react to the news on vaccines (Demir et al. 2021; Rouatbi et al. 2021), focusing on the travel and leisure industry. While few studies scrutinize this issue (Chan et al. 2022; Acharya et al. 2021), there is not yet a study that focuses on the travel and leisure industry where vaccinations play a crucial role.

The remainder of the article proceeds as follows. Section 2 describes our data and methodology. Section 3 presents the empirical findings. Finally, Section 4 discusses the research findings and concludes.

2. Data and Methodology

This paper aims to explore the impact of vaccination programs on the stock price volatility of travel and leisure companies. The choice of the sample depended on the financial and vaccination data availability. In terms of the stock market data, we searched and collected all the daily travel and leisure index data from Datastream Global Equity Indices. After that, we obtained vaccination-related data from the COVID-19 Data Hub website, which is funded by the Institute for Data Valorization.[2] We matched the country-level stock index data with the vaccination data. China was excluded from the sample due to a lack of daily vaccination data.[3] Our final sample comprised 56 countries from 1 January 2020 to 30 March 2021.[4] China declared several pneumonia cases of an unknown cause in Wuhan on 31 December 2019; therefore, we used the first trading day following this announcement. Table 1 presents the list of stock markets in our sample. Notably, our equity universe covers the top tourist destinations worldwide in developed (e.g., France, Spain) and emerging (e.g., Turkey, Mexico) markets.

Table 1. Countries covered by the study.

Developed Markets				Emerging Markets					
1.	Australia	13.	New Zealand	22.	Bahrain	34.	Malaysia	46.	Saudi Arabia
2.	Austria	14.	Norway	23.	Brazil	35.	Malta	47.	Slovakia
3.	Canada	15.	Portugal	24.	Bulgaria	36.	Mexico	48.	Slovenia
4.	Denmark	16.	Singapore	25.	Chile	37.	Morocco	49.	South Africa
5.	Finland	17.	Spain	26.	Croatia	38.	Nigeria	50.	South Korea
6.	France	18.	Sweden	27.	Cyprus	39.	Oman	51.	Sri Lanka
7.	Germany	19.	Switzerland	28.	Egypt	40.	Pakistan	52.	Taiwan
8.	Ireland	20.	United Kingdom	29.	Estonia	41.	Peru	53.	Thailand
9.	Israel	21.	United States	30.	Greece	42.	Philippines	54.	Turkey
10.	Italy			31.	India	43.	Poland	55.	UAE
11.	Japan			32.	Jordan	44.	Romania	56.	Vietnam
12.	Netherlands			33.	Kuwait	45.	Russia		

This table shows the lists of developed and emerging markets covered by our study.

Figure 1 depicts the variation over time in the average volatility of returns on travel and leisure industry stocks for the whole sample (solid blue line), as well as for the subsamples of countries classified into developed (long-dashed red line) and emerging (dashed green line) markets. Panels A and B show the equal-weighted and capitalization-weighted volatility measures, respectively. The figure uncovers that volatility markedly rose in March—April 2020, when the COVID–19 outbreak was declared a pandemic by the WHO. Following the launch of mass vaccinations, the volatility appears to have declined in both the developed and emerging market countries. One possible reason is that COVID-19 vaccinations helped stabilize the stock market, particularly the travel and leisure industry.

We used the following model (subscripts are dropped for notational convenience) in line with the literature (Bae et al. 2021; Zaremba et al. 2020):

$$VOLATILITY = \alpha + \beta \cdot VACCINATION + \Gamma' \cdot CONTROL + \Lambda' \cdot TIME + \varepsilon \quad (1)$$

where *VOLATILITY* is proxied by two measures: (1) Log $|R|$ denotes the logarithm of absolute daily returns, (2) Log $|RR_{CAPM}|$ indicates the logarithm of absolute residual returns from the CAPM (Schwert 1989). We used absolute values to measure volatility in line with Antonakakis and Kizys (2015). Moreover, we calculated the logarithmic transformation of the dependent variables to (i) ensure that daily volatility in levels is positive definite and (ii) to control for non-linearities in the relation between the level of volatility and its covariates (Zaremba et al. 2020). $|RR_{CAPM}|$ was calculated using rolling regressions that utilized 60 months of daily data. The market risk factor in the model is represented by the capitalization-weighted portfolio of all the country equity indices in the sample. The risk-free rate was downloaded from Kenneth R. French's database.[5]

Our primary variable of interest is the *VACCINATION* variable. To confirm the robustness of our results, we considered four various vaccination-related variables. These were Log (Daily Vaccinations), Daily Vaccinations per 100,000, Vaccination Period, and Δ Daily Vaccinations Dummy. *Log (Daily Vaccinations)* indicates the logarithm of the count of daily COVID-19 vaccinations. *Daily Vaccinations per* 100,000 was calculated as the number of daily COVID-19 vaccinations scaled by the population in a country and then multiplied by 100,000. Countries that immunize a larger population share on a given day can attain herd immunity sooner than countries that immunize a smaller population share. Admittedly, travel and leisure stocks can be perceived as a less risky vehicle of investment in these countries. Staggered vaccination rates across countries can lead to portfolio rebalancing across countries. Investors can sell travel and leisure stocks in countries with lower vaccination rates and invest in countries with higher vaccination rates. *Vaccination Period* denotes a dummy variable equal to one for the period starting from the country's first vaccination day, and is zero otherwise. Countries with a relatively earlier rollout of mass vaccination campaigns can achieve herd immunity earlier than countries that launch mass vaccinations later. These countries can also reopen to international tourism earlier and can be perceived as safer locations for stock investments. Δ *Daily Vaccinations Dummy* is the variable that takes the value of one if the daily change in the number of COVID-19 vaccinations is strictly positive—and zero otherwise. If there is an increase in the number of vaccinations relative to the previous day, this can be regarded as positive news by stock investors. Overall, we expected to find a negative impact of those vaccination-related variables on stock market volatility. This implies that accessing COVID-19 vaccines will lower the stock market volatility.

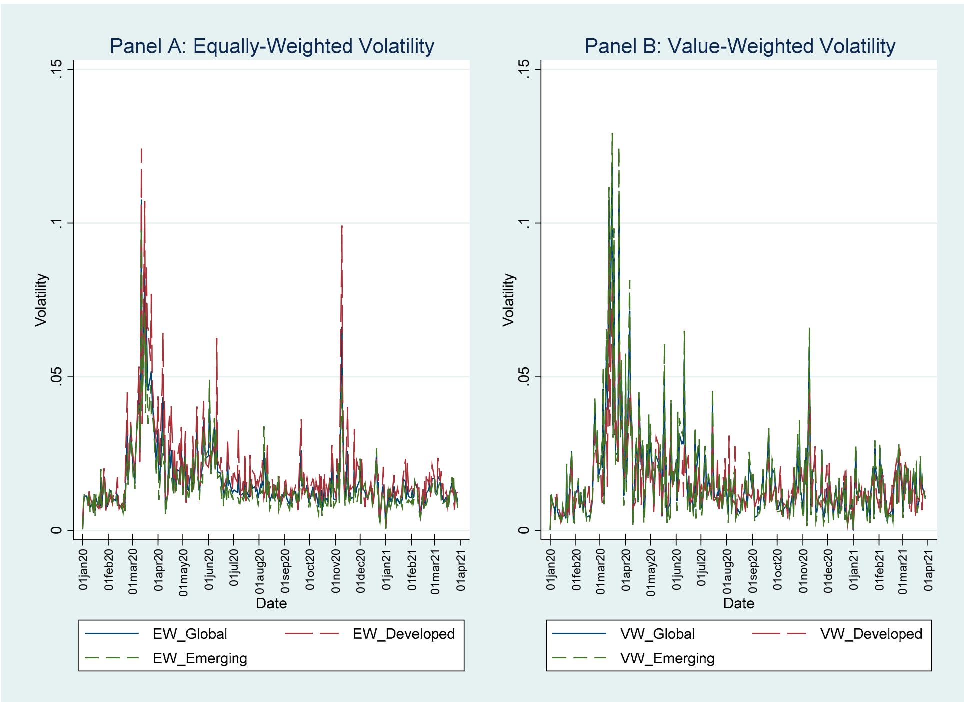

Figure 1. Volatility in international markets during the COVID-19 pandemic. The figure presents the average daily absolute returns on investment in travel and leisure stocks across countries covered. The presented measures of volatility are for the whole sample (solid blue line), the sub-sample of developed countries (long-dashed red line) and the sub-sample of emerging markets (dashed green line). The research period is from 1 January 2020 to 30 March 2021. Panels A and B report equal-weighted averages and value-weighted averages, respectively.

We introduced several control variables, *CONTROLS*, that can affect stock market volatility in line with previous studies (e.g., Bae et al. 2021; Zaremba et al. 2020). Γ' is a row vector of population coefficients that quantify the effects of the control variables. First, the *Stringency Index* of Hale et al. (2021) was considered in the estimation. This index measures the stringency of the government policy response to the COVID-19 pandemic and takes a value between 0 and 100. Governments have implemented several measures; these include school closing, restrictions on domestic and international travel, and the cancellation of public events in order to flatten the curve. The index is widely used in the recent pandemic literature as a factor affecting stock markets (Aggarwal et al. 2021; Baig et al. 2021; Chen et al. 2020; Feng et al. 2021). *BM* is the book-to-market ratio. *Log (MV)* is the logarithm of market capitalization in U.S. dollars. *Turnover* is the turnover ratio that was calculated as a 12-month average trading volume over the corresponding aggregate market capitalization. Δ *Cases to Tests* is the change in the daily number of COVID-19 infections to the daily number of tests (in percentage). Δ *Deaths* is the daily change in the number of COVID-19 fatalities. The previous studies document that COVID-19-related deaths can influence the stock markets, so they should be considered in the estimations (Chen et al. 2020; Seven and Yılmaz 2021; Zaremba et al. 2020). Finally, by means of the set of indicator variables (*TIME*), we also controlled for the day of the week and month effects (Zhang et al. 2017). Λ' is a row vector of population coefficients that quantify the day of the week and month effects on the daily volatility of returns on the travel and leisure industry stocks. Finally, $\varepsilon_{i,t}$ is the composite random disturbance term. The fixed-effects estimation method implies that $\varepsilon_{i,t}$ comprises two components: the unobserved country-specific volatility effect, u_i, and the idiosyncratic shock term, $v_{i,t}$.

Table 2 exhibits the descriptive statistics of all variables used in the analysis. We winsorized all continuous variables at the 1st and the 99th percentiles to minimize the effect of outliers (Chia et al. 2020). On average, 41 inhabitants were vaccinated in a population of 100,000 per day (Panel A). This low average can be explained by the fact that vaccinations started in early 2021, making most of our sample's observations outside the vaccination period. Furthermore, we observe high variability in the Stringency Index across countries.

Table 3 shows the pairwise correlation coefficients between explanatory variables. Not surprisingly, the correlation coefficients between the vaccination-related variables are high (more than 0.6). The remaining correlation coefficients, however, are very low; this indicates that multicollinearity is not likely to present a problem in our empirical analysis.

Model 1 was mainly estimated using a fixed-effects estimator, which considers any unobserved heterogeneity in the stock market volatility across countries. Moreover, it allows for arbitrary correlation between the unobserved country fixed effects and the observed explanatory variables. In addition to fixed effects, we also estimated Model 1 with pooled OLS and random effects estimators (see robustness checks below).

In addition, we performed additional robustness tests by considering alternative dependent variables, incorporating additional control variables, and considering an alternative sample period. We also divided our sample into developed and emerging market countries, as emerging market countries have limited access to COVID-19 vaccines.

Table 2. Descriptive statistics.

Variables	Log ∣R∣	Log ∣RR_{CAPM}∣	Log (Daily Vaccinations)	Daily Vaccinations Per 100,000	Vaccination Period	ΔDaily Vaccinations Dummy	Stringency Index	BM	Turnover	Log (MV)	ΔCases to Cases	ΔDeaths to Cases
Panel A: Descriptive statistics: Full sample												
Mean	−5.181	−5.084	1.278	41.130	0.159	0.074	54.057	0.713	5.100	7.631	0.006	0
Std. Dev.	1.805	1.478	3.465	156.976	0.366	0.262	26.016	0.769	10.784	2.057	0.072	0.001
25th Quartile	−5.979	−5.941	0	0	0	0	40.740	0.234	0.317	6.173	−0.003	0
Median	−4.822	−4.854	0	0	0	0	60.190	0.501	1.653	7.652	0	0
75th Quartile	−3.919	−4.026	0	0	0	0	73.150	1.212	4.480	8.939	0.004	0
Panel B: Descriptive statistics: Emerging markets												
Mean	−5.510	−5.290	1.064	32.224	0.145	0.059	54.805	0.854	6.031	6.841	0.006	0
Std. Dev.	1.936	1.562	3.153	139.845	0.352	0.235	26.696	0.899	13.724	1.653	0.074	0.001
25th Quartile	−6.448	−6.293	0	0	0	0	41.670	0.272	0.093	5.755	−0.003	0
Median	−5.144	−5.057	0	0	0	0	60.190	0.772	0.899	6.792	0	0
75th Quartile	−4.129	−4.139	0	0	0	0	75.000	1.537	3.930	8.295	0.005	0
Panel C: Descriptive statistics: Developed markets												
Mean	−4.659	−4.758	1.617	55.257	0.183	0.099	52.870	0.490	3.943	8.886	0.006	0
Std. Dev.	1.429	1.266	3.886	179.962	0.387	0.299	24.853	0.406	4.935	2.013	0.069	0.001
25th Quartile	−5.321	−5.413	0	0	0	0	38.890	0.217	0.891	7.357	−0.002	0
Median	−4.444	−4.592	0	0	0	0	59.260	0.388	2.711	8.370	0	0
75th Quartile	−3.719	−3.900	0	0	0	0	71.300	0.614	4.755	10.450	0.004	0

This table displays statistical properties of the variables used in our main analysis for the full sample (Panel A), the subsample of emerging markets (Panel B), and the subsample of developed markets (Panel C). Log ∣R∣ and Log ∣RR_{CAPM}∣ denote the logarithm of absolute daily returns and the logarithm of residual returns from the CAPM, respectively. Log (Daily Vaccinations) indicates the logarithm of the number of daily COVID-19 vaccinations. Daily Vaccinations per 100,000 represents the number of daily COVID-19 vaccinations scaled by the population of a country (multiplied by 100,000). Vaccination Period denotes a dummy variable taking the value of one for the period starting from the country's first vaccination day and zero otherwise. Δ Daily Vaccinations Dummy is an indicator variable that amounts to one if the daily change in the number of COVID-19 vaccinations is strictly positive and zero otherwise. Stringency Index reflects the government response to the pandemic and ranges between 0 and 100. BM is the book-to-market ratio; turnover is stock turnover; Log (MV) is the logarithm of market value in U.S. dollars. Δ Cases to Cases represents the daily change in the number of COVID-19 infections scaled by the total number of confirmed cases. Δ Deaths to Cases is the daily change in the number of COVID-19 fatalities to the aggregate number of confirmed infections. We winsorized the continuous variables at the 1st and 99th percentiles.

Table 3. Pairwise correlation coefficients between major variables.

	1.	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**
1. Log (Daily Vaccinations)	1.000									
2. Daily Vaccinations Per 100,000	0.752 ***	1.000								
3. Vaccination Period	0.845 ***	0.601 ***	1.000							
4. Δ Daily Vaccinations Dummy	0.759 ***	0.621 ***	0.648 ***	1.000						
5. Stringency Index	0.205 ***	0.150 ***	0.212 ***	0.149 ***	1.000					
6. BM	−0.074 ***	−0.054 ***	−0.075 ***	−0.048 ***	0.012	1.000				
7. Turnover	−0.013	−0.014 *	−0.051 ***	−0.026 ***	0.099 ***	0.109 ***	1.000			
8. Log (MV)	0.079 ***	0.059 ***	0.046 ***	0.065 ***	−0.049 ***	−0.451 ***	0.155 ***	1.000		
9. Δ Cases to Cases	−0.029 ***	−0.016 **	−0.037 ***	−0.014 *	−0.115 ***	−0.005	0.023 ***	0.002	1.000	
10. Δ Deaths to Cases	−0.015 *	−0.007	−0.021 ***	−0.004	0.007	−0.004	0.021 **	0.006	0.311 ***	1.000

This table shows pairwise correlations between the explanatory variables used in our main regressions. Log (Daily Vaccinations) indicates the logarithm of the number of daily COVID-19 vaccinations. Daily Vaccinations per 100,000 represents the number of daily COVID-19 vaccinations scaled by the population of a country (multiplied by 100,000). Vaccinations Period denotes a dummy variable taking the value of one for the period starting from the country's first vaccination day and zero otherwise. Δ Daily Vaccinations Dummy is an indicator variable that amounts to one if the daily change in the number of COVID-19 vaccinations is strictly positive and zero otherwise. Stringency Index reflects the government response to the pandemic and ranges between 0 and 100. BM is the book-to-market ratio; turnover is stock turnover; Log (MV) is the logarithm of market value in U.S. dollars. Δ Cases to Cases represents the daily change in the number of COVID-19 infections scaled by the total number of confirmed cases. Δ Deaths to Cases is the daily change in the number of COVID-19 fatalities to the aggregate number of confirmed infections. We winsorized the continuous variables at the 1st and 99th percentiles. The asterisks ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

3. Empirical Findings

This section examines the results from our panel data models, which were estimated using the fixed effects approach. We begin with reporting our baseline results; these are, in turn, supplemented with further robustness checks. Finally, we turn to differences in the magnitude of the effect between developed and emerging markets.

3.1. Baseline Results

Table 4, summarizing our baseline results, is organized into two blocks. In the first block of the table (Columns 1–4), the dependent variable is the natural logarithm of absolute returns. In the second block (Columns 5–8), the dependent variable is the natural logarithm of absolute residual returns, estimated by employing the CAPM. To evaluate the impact of mass vaccinations on the volatility of returns on travel and leisure stocks, we utilized four different predictors, which also carried different information sets. The main predictor of volatility in international stock markets is the logarithm of the daily number of COVID-19 vaccinations (Columns 1 and 5). The coefficient of this predictor can be regarded as vaccination elasticity of volatility. As an alternative indicator of the scale of vaccinations, we used Daily Vaccinations per 100,000 inhabitants (Columns 2 and 6). The coefficient of this predictor shows the percentage rate of change in volatility when one more inhabitant in a population of 100,000 is inoculated. A third predictor is the so-called Vaccination Period (Columns 3 and 7), which takes on the value of one on the day when mass vaccinations were rolled out in a country. It aims to answer whether the volatility of the tourism industry's stock returns responds more strongly to an early launch of mass vaccinations instead of a late rollout. A fourth predictor also aims to evaluate the effects of the vaccination rate (Columns 4 and 8). This predictor takes a value of one if the number of immunized people on a given day is strictly higher than on the previous day, and it takes on a value of zero otherwise. Thus, the purpose of this variable is to ascertain whether a rise in the vaccination rate can stabilize international stock markets.

The results displayed in Table 4 are as follows. First, Columns 1 and 5 indicate that the logarithm of mass vaccination exerts a negative and significant effect (at the 1% significance level); a 10% increase in the number of vaccinations reduces volatility by 0.378% if absolute returns are used to compute volatility, and by 0.286% if volatility is measured with absolute residual returns. We further scrutinized the coefficient estimates for the second measure of daily vaccinations. Columns 2 and 6 indicate that if 1000 inhabitants in a population of 100,000 are immunized per day, volatility decreases by 0.5% for both absolute returns (Column 2) and absolute residual returns (Column 6). Further, considering Columns 3 and 7, we find that an early rollout of vaccines has a negative effect on the volatility of the travel and leisure industry's stock returns. The rollout of vaccinations caused a decline in volatility of 0.4872% and 0.3809% in absolute returns (Column 3) and absolute residual returns (Column 7), respectively. Our results also show that a higher vaccination rate is associated with more stable international stock markets, as Columns 4 and 8 appear to indicate. Concretely, if more inhabitants are inoculated on a given day compared to the previous day, volatility decreases by 0.2448% and 0.2135% for absolute returns (Column 4) and absolute residual returns (Column 8), respectively.

3.2. Robustness Checks

Our baseline findings are validated by a series of robustness checks, as is displayed in Tables 5 and 6. These tests concern different stages and aspects of our research process.

Table 4. Primary regressions.

	Dependent Variable: Log ∣R∣				Dependent Variable: Log ∣RR_{CAPM}∣			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Log (Daily Vaccinations)$_{t-1}$	−0.0378 ***				−0.0286 ***			
	(−6.44)				(−4.89)			
Daily Vaccinations Per 100,000$_{t-1}$		−0.0005 ***				−0.0005 ***		
		(−3.69)				(−4.50)		
Vaccination Period			−0.4872 ***				−0.3809 ***	
			(−7.54)				(−5.83)	
Δ Daily Vaccinations Dummy$_{t-1}$				−0.2448 ***				−0.2135 ***
				(−4.18)				(−4.16)
Stringency Index$_{t-1}$	−0.0018	−0.0032 ***	−0.0007	−0.0033 ***	0.0006	−0.0002	0.0016	−0.0005
	(−1.54)	(−2.94)	(−0.58)	(−2.83)	(0.57)	(−0.21)	(1.51)	(−0.47)
BM$_{t-1}$	0.2723	0.2655	0.2857 *	0.3554 *	0.1176	0.0965	0.1235	0.1777
	(1.55)	(1.48)	(1.73)	(1.81)	(1.07)	(0.88)	(1.17)	(1.48)
Turnover$_{t-1}$	0.0152 ***	0.0158 ***	0.0147 ***	0.0160 ***	0.0125 ***	0.0128 ***	0.0121 ***	0.0130 ***
	(3.35)	(3.47)	(3.37)	(3.41)	(3.11)	(3.23)	(3.16)	(3.16)
Log (MV)$_{t-1}$	−0.2335 **	−0.2793 ***	−0.1918 **	−0.2747 ***	−0.1930 **	−0.2227 ***	−0.1581 *	−0.2272 **
	(−2.41)	(−2.99)	(−2.06)	(−2.73)	(−2.31)	(−2.82)	(−1.92)	(−2.64)
Δ Cases to Cases$_{t-1}$	0.1618	0.1946	0.1191	0.2166	0.5289 ***	0.5404 ***	0.4947 ***	0.5601 ***
	(0.83)	(0.99)	(0.61)	(1.10)	(2.90)	(3.04)	(2.79)	(3.08)
Δ Deaths to Cases$_{t-1}$	−4.2655	−2.4980	−5.4021	−2.4986	−1.2914	−0.6183	−2.3240	−0.3476
	(−0.41)	(−0.24)	(−0.52)	(−0.24)	(−0.14)	(−0.07)	(−0.25)	(−0.04)
Weekday Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
#Obs.	12,869	12,869	12,872	12,827	12,869	12,869	12,872	12,827
R^2 within	0.0595	0.0574	0.0615	0.0565	0.0503	0.0499	0.0523	0.0484

This exhibit reports the fixed-effects estimates of the relation between COVID-19 vaccinations and equity returns volatility. The dependent variables include the logarithm of absolute daily returns (Log ∣R∣, Columns (1)–(4)) and the logarithm of absolute residual returns from the CAPM model (Log ∣RR_{CAPM}∣, Columns (5)–(8)). Log (Daily Vaccinations) indicates the logarithm of the number of daily COVID-19 vaccinations. Daily Vaccinations per 100,000 represents the number of daily COVID-19 vaccinations scaled by the population of a country (multiplied by 100,000). Vaccination Period denotes a dummy variable taking the value of one for the period starting from the country's first vaccination day and zero otherwise. Δ Daily Vaccinations Dummy is an indicator variable that amounts to one if the daily change in the number of COVID-19 vaccinations is strictly positive and zero otherwise. Stringency Index reflects the government response to the pandemic and ranges between 0 and 100. BM is the book-to-market ratio; turnover is stock turnover; Log (MV) is the logarithm of market value in U.S. dollars. Δ Cases to Cases represents the daily change in the number of COVID-19 infections scaled by the total number of confirmed cases. Δ Deaths to Cases is the daily change in the number of COVID-19 fatalities to the aggregate number of confirmed infections. We winsorized the continuous variables at the 1st and 99th percentiles. The numbers in parentheses are *t*-statistics based on standard errors clustered at the country level. The asterisks ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 5. Robustness tests—alternative estimation methods and dependent variables.

	Panel A: Alternative Regression Frameworks											
	Pooled OLS				**Random effects**							
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**				
Log (Daily Vaccinations)$_{t-1}$	−0.0311 ***				−0.0445 ***							
	(−3.03)				(−7.54)							
Daily Vaccinations Per 100,000$_{t-1}$		−0.0005 **				−0.0007 ***						
		(−2.48)				(−4.65)						
Vaccination Period			−0.5277 ***				−0.5717 ***					
			(−5.11)				(−9.06)					
Δ Daily Vaccinations Dummy$_{t-1}$				−0.2202 **				−0.2976 ***				
				(−2.32)				(−4.89)				
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
Weekday and Month Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
Obs.	12,869	12,869	12,872	12,827	12,869	12,869	12,872	12,827				
R^2 within	0.0725	0.0716	0.0774	0.0705	0.0562	0.0535	0.0587	0.0524				
	Panel B: Alternative Measures of Volatility											
	Dependent Variable: Log $\mid RR_{FF} \mid$				**Dependent Variable: Log $\mid RR_{AMP} \mid$**				**Dependent Variable: Log $\mid RR_{CAR} \mid$**			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
Log (Daily Vaccinations)$_{t-1}$	−0.0290 ***				−0.0291 ***				−0.0292 ***			
	(−5.05)				(−5.08)				(−4.95)			
Daily Vaccinations Per 100,000$_{t-1}$		−0.0005 ***				−0.0005 ***				−0.0005 ***		
		(−4.36)				(−4.03)				(−4.03)		
Vaccination Period			−0.3951 ***				−0.4129 ***				−0.4146 ***	
			(−6.90)				(−7.34)				(−7.07)	

Table 5. *Cont.*

Panel B: Alternative Measures of Volatility												
	Dependent Variable: Log ∣RR_{FF}∣				**Dependent Variable: Log ∣RR_{AMP}∣**				**Dependent Variable: Log ∣RR_{CAR}∣**			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
Δ Daily Vaccinations Dummy$_{t-1}$				−0.1996 ***				−0.2176 ***				−0.1903 ***
				(−4.49)				(−4.70)				(−3.82)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Weekday and Month Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	12,869	12,869	12,872	12,827	12,869	12,869	12,872	12,827	12,869	12,869	12,872	12,827
R^2 within	0.0574	0.0566	0.0597	0.055	0.0565	0.0551	0.0593	0.0544	0.0571	0.0558	0.06	0.0545

This table presents the results of the first set of sensitivity tests. Panel A reports results from pooled OLS (Columns (1)–(4)) and random effects (Columns (5)–(8)) estimations using the logarithm of absolute daily returns (Log ∣R∣) as a dependent variable. Panel B concerns the use of alternative dependent variables: the logarithms of absolute residual returns from the models of Fama and French (1993) (Log ∣RR_{FF}∣, Columns (1)–(4)); Asness et al. (2013) (Log ∣RR_{AMP}∣, Columns (5)–(8)); and Carhart (1997) (Log ∣RR_{CAR}∣, Columns (9)–(12)). Log (Daily Vaccinations) indicates the logarithm of the number of daily COVID-19 vaccinations. Daily Vaccinations per 100,000 represents the number of daily COVID-19 vaccinations scaled by the population of a country (multiplied by 100,000). Vaccination Period denotes a dummy variable taking the value of one for the period starting from the country's first vaccination day and zero otherwise. Δ Daily Vaccinations Dummy is an indicator variable that amounts to one if the daily change in the number of COVID-19 vaccinations is strictly positive and zero otherwise. All specifications include weekday and month dummies. We winsorized the continuous variables at the 1st and 99th percentiles. The numbers in parentheses are *t*-statistics based on standard errors clustered at the country level. The asterisks ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 6. Robustness checks—further control variables and modified study period.

Panel A: Additional Control Variables												
	Log (TV)$_{t-1}$				**Momentum$_{t-1}$**				**Crisis**			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
Log (Daily Vaccinations)$_{t-1}$	−0.0446 ***				−0.0353 ***				−0.0248 ***			
	(−7.91)				(−5.55)				(−4.47)			
Daily Vaccinations Per 100,000$_{t-1}$		−0.0007 ***				−0.0005 ***				−0.0004 **		
		(−4.82)				(−3.33)				(−2.52)		
Vaccination Period			−0.5584 ***				−0.4649 ***				−0.3133 ***	
			(−9.75)				(−6.69)				(−4.95)	

Table 6. *Cont.*

Panel A: Additional Control Variables												
	Log (TV)$_{t-1}$				**Momentum$_{t-1}$**				**Crisis**			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
Δ Daily Vaccinations Dummy$_{t-1}$				−0.3072 ***				−0.2180 ***				−0.1453 **
				(−5.16)				(−3.62)				(−2.51)
Additional Control Variable	0.1214 ***	0.1245 ***	0.1180 ***	0.1234 ***	−0.1412	−0.2060 *	−0.1428	−0.2238 **	0.6516 ***	0.6967 ***	0.5956 ***	0.7432 ***
	(5.05)	(5.18)	(5.05)	(5.29)	(−1.25)	(−1.92)	(−1.50)	(−2.02)	(7.77)	(8.02)	(7.34)	(8.71)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Weekday and Month Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	12,869	12,869	12,872	12,827	12,869	12,869	12,872	12,827	12,869	12,869	12,872	12,827
R^2 within	0.0609	0.0578	0.0636	0.0569	0.0599	0.0582	0.0619	0.0574	0.0662	0.0654	0.0668	0.0656
Panel B: Alternative Study Period (Starting from 11 March 2020)												
	Fixed Effects				**Pooled OLS**				**Random Effects**			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
Log (Daily Vaccinations)$_{t-1}$	−0.0416 ***				−0.0319 ***				−0.0493 ***			
	(−6.61)				(−3.18)				(−7.99)			
Daily Vaccinations Per 100,000$_{t-1}$		−0.0006 ***				−0.0005 **				−0.0007 ***		
		(−3.33)				(−2.39)				(−4.47)		
Vaccination Period			−0.5706 ***				−0.5925 ***				−0.6728 ***	
			(−7.90)				(−5.81)				(−9.75)	
Δ Daily Vaccinations Dummy$_{t-1}$				−0.2579 ***				−0.2172 **				−0.3169 ***
				(−4.41)				(−2.47)				(−5.22)

Table 6. *Cont.*

Panel B: Alternative Study Period (Starting from 11 March 2020)												
	Fixed Effects				**Pooled OLS**				**Random Effects**			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Weekday and Month Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	12,038	12,038	12,038	12,038	12,038	12,038	12,038	12,038	12,038	12,038	12,038	12,038
R^2 within	0.0598	0.0570	0.0627	0.0598	0.0718	0.0708	0.0775	0.0695	0.0558	0.0521	0.0595	0.0505

This table presents the results of a second set of sensitivity tests. In all regressions, the dependent variable is the natural logarithm of absolute daily returns, Log ∣R∣. Panel A shows regression results after including three variables, one at a time, as additional controls to our main regressions. Namely, (i) Log (TV), defined as the logarithm of trading volume in U.S. dollars. When using this variable, we did not include Log (MV) and Turnover in our regression to avoid multicollinearity; (ii) Momentum is the total stock return in the past 250 trading days; and iii) Crisis, which is a dummy variable that equals one for the COVID-19 crisis period from 18 February to 20 March 2020 (Bae et al. 2021) and zero otherwise. In Panel B, we rerun our main regressions after considering an alternative study period that starts at 11 March 2020 and ends at 29 March 2021. Log (Daily Vaccinations) indicates the logarithm of the number of daily COVID-19 vaccinations. Daily Vaccinations per 100,000 represents the number of daily COVID-19 vaccinations scaled by the population of a country (multiplied by 100,000). Vaccination Period denotes a dummy variable taking the value of one for the period starting from the country's first vaccination day and zero otherwise. Δ Daily Vaccinations Dummy is an indicator variable that amounts to one if the daily change in the number of COVID-19 vaccinations is strictly positive and zero otherwise. All specifications include weekday and month dummies. We winsorized the continuous variables at the 1st and 99th percentiles. The numbers in parentheses are t-statistics based on standard errors clustered at the country level. The asterisks ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Alternative estimation methods. Our default approach assumed estimations of fixed-effects models. To ensure that our findings did not hang on this approach, we replicated our analysis using pooled OLS and random effects estimators (Table 5, Panel A). Both estimators produced qualitatively similar results to the fixed effects estimator. Notably, the four measures of mass vaccinations appeared to exert both negative and significant effects on the volatility of the tourism industry's stocks.

Alternative measures of volatility. In Table 5, Panel B, we vary the asset pricing model, which is used to estimate residual returns. In Columns 1–4, the three-factor model, developed by Fama and French (1993), is used to estimate the residual return. In Columns 5–8, the residual return is derived from Asness et al.'s (2013) asset pricing model. In Columns 9–12, the residual return is estimated based on Carhart's asset pricing model (1997). The precise residuals calculation procedures closely follow Zaremba et al. (2020). Notably, the coefficient estimates are always negative and significant at the 1% significance level; also, the strength of the estimated effect is numerically similar for the same measure of mass vaccinations.

Additional control variables. In Table 6, Panel A, we visualize coefficient estimates of further extensions of the baseline model. These extensions entail explanatory variables; such as turnover ratio (Log $(TV)_{t-1}$), momentum ($Momentum_{t-1}$), or crisis dummy (Crisis). Log (TV) indicates the logarithm of trading volume expressed in U.S. dollars.[6] Momentum is the total stock return in the past 250 trading days. Finally, Crisis is a dummy variable that takes value one for the COVID-19 crisis period from 18 February to 20 March 2020 (Bae et al. 2021) and zero otherwise. Its use aims at accounting for the potentially elevated volatility during the most intense initial pandemic crisis. Our principal conclusions are intact in all these additional specifications, corroborating the stabilizing influence of vaccinations on the tourism sector.

Modified study period. To ascertain that our findings were not specific to our study period, we also considered an alternative start date; namely, the date at which the WHO considered the COVID-19 as a pandemic (11 March 2020). This approach excludes the initial weeks of the intense global market downturn that culminated on 11 March 2020. We perform this exercise using fixed effects, pooled OLS, and random effects estimators (Table 6, Panel B). Our principal findings remain unchanged, and the coefficients on vaccination-related variables remain negative and significant at the 5% level.

To sum up, the additional robustness checks confirmed the validity of our findings. The vaccination programs help to decrease the volatility of the travel and leisure companies.

3.3. Vaccinations and Market Development

Having established the essential relationship between vaccinations and the risk of travel and leisure companies, we now carry on with providing further insights. We now concentrate on the impact of vaccinations on both emerging and developed markets.

Table 7 reports additional explorations of the role of market development. We seek to ascertain if the observed negative effect is not confined to a particular group of countries. To this end, we divided our sample into developed and emerging market countries. Such a division was determined by the difference in the scale, timeliness, and speed in mass vaccinations in the two groups of countries. This is because emerging market countries have limited access to COVID-19 vaccines when compared with developed countries.

Table 7. The vaccination effect in developed and emerging markets.

	Emerging	Developed	Emerging	Developed	Emerging	Developed	Emerging	Developed
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Log (Daily Vaccinations)$_{t-1}$	−0.0394 ***	−0.0340 ***						
	(−4.00)	(−4.68)						
Daily Vaccinations Per 100,000$_{t-1}$			−0.0007 ***	−0.0003 *				
			(−2.86)	(−1.99)				
Vaccination Period					−0.5330 ***	−0.4080 ***		
					(−5.60)	(−4.37)		
Δ Daily Vaccinations Dummy$_{t-1}$							−0.2647 **	−0.1898 ***
							(−2.40)	(−3.25)
Stringency Index$_{t-1}$	−0.0038 **	0.0006	−0.0049 ***	−0.0012	−0.0025	0.0013	−0.0050 ***	−0.0011
	(−2.04)	(0.41)	(−2.83)	(−0.98)	(−1.42)	(0.92)	(−2.79)	(−0.74)
BM$_{t-1}$	0.2109	0.1321	0.2229	0.0952	0.2205	0.2183	0.3089	0.1549
	(1.01)	(0.66)	(1.05)	(0.48)	(1.10)	(1.12)	(1.30)	(0.81)
Turnover$_{t-1}$	0.0105 ***	0.0449 ***	0.0110 ***	0.0462 ***	0.0098 ***	0.0448 ***	0.0110 ***	0.0470 ***
	(3.02)	(7.83)	(3.18)	(7.65)	(3.09)	(7.87)	(3.13)	(7.95)
Log (MV)$_{t-1}$	−0.2012 *	−0.3499 **	−0.2590 **	−0.4064 ***	−0.1770	−0.2522 *	−0.2361 **	−0.4162 ***
	(−1.84)	(−2.83)	(−2.45)	(−3.51)	(−1.63)	(−1.75)	(−2.16)	(−3.34)
Δ Cases to Cases$_{t-1}$	0.0747	0.2768	0.1076	0.3238	0.0121	0.2680	0.1302	0.3308
	(0.25)	(1.26)	(0.37)	(1.38)	(0.04)	(1.26)	(0.44)	(1.44)
Δ Deaths to Cases$_{t-1}$	1.1800	−11.5439	2.5303	−8.5181	−0.9133	−10.9465	2.7561	−9.4817
	(0.08)	(−0.79)	(0.17)	(−0.56)	(−0.06)	(−0.74)	(0.18)	(−0.63)
Weekday Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	7047	5822	7047	5822	7049	5823	7022	5805
R^2 within	0.0546	0.0770	0.0535	0.0736	0.0580	0.0773	0.0518	0.0739

The table shows fixed-effects estimates of the relation between COVID-19 vaccinations and equity volatility in emerging and developed countries. The left-hand side variable is the logarithm of absolute daily returns, Log |R|. Log (Daily Vaccinations) indicates the logarithm of the number of daily COVID-19 vaccinations. Daily Vaccinations per 100,000 represents the number of daily COVID-19 vaccinations scaled by the population of a country (multiplied by 100,000). Vaccination Period denotes a dummy variable taking the value of one for the period starting from the country's first vaccination day and zero otherwise. Δ Daily Vaccinations Dummy is an indicator variable that amounts to one if the daily change in the number of COVID-19 vaccinations is strictly positive and zero otherwise. Stringency Index reflects the government response to the pandemic and ranges between 0 and 100. BM is the book-to-market ratio; turnover is stock turnover; Log (MV) is the logarithm of market value in U.S. dollars. Δ Deaths to Cases is the daily change in the number of COVID-19 fatalities to the aggregate number of confirmed infections. We winsorized the continuous variables at the 1st and 99th percentiles. The numbers in parentheses are *t*-statistics based on standard errors clustered at the country level. The asterisks ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Results are organized in eight columns. Columns 1, 3, 5, and 7 visualize estimations for the emerging market countries. The remaining columns (2, 4, 6, and 8) show estimations for the developed countries for the four indicators of mass vaccinations. The general picture that emerges from Table 5 is that the effect of mass vaccinations on the volatility of the tourism industry's stock is not sensitive to a group of countries. Nevertheless, analysis reveals that the effect is relatively stronger for emerging market countries. In these countries, the lower incidence of mass vaccinations has a larger marginal effect on the tourism industry in this group of countries, adding a significant value to their income. The effect is particularly pronounced for Daily Vaccinations Per $100{,}000_{t-1}$ and Δ Daily Vaccinations Dummy_{t-1}. For instance, for the number of daily vaccinations, the 1000 people receiving shots per 100,000 inhabitants per day results in a drop in volatility by 0.7% in emerging markets, compared with 0.3% in developed markets.

4. Discussion

Mass vaccinations are of paramount importance for the tourism industry, decimated by the COVID-19 pandemic and the ensuing confinement and closure policies launched by governments around the globe. Our results show that following the rollout of mass vaccinations, the volatility of tourism industry stocks significantly decreased. Stock market investors now regard tourism stocks as a less risky and uncertain investment vehicle. This is because countries that are on track to achieve herd immunity through vaccinations are contemplating the possibility of reopening their borders for international travel. Investors closely monitor vaccination rates across countries. Vaccination rates can influence stock market volatility in the short and long run. First, staggered vaccination rates across countries provide opportunities for profitable investment opportunities in the short run. Equipped with the vaccination data, investors can rebalance their portfolios towards tourism industry stocks in relatively more vaccinated countries, which are expected to remove travel restrictions earlier and faster than countries with lower vaccination rates. This can reduce travel and leisure stock volatility in countries with relatively earlier rollouts of mass vaccinations and relatively higher vaccination rates. Second, in the long run, mass vaccinations are expected to reduce global economic uncertainty, which can be perceived as good news by investors in travel and leisure stocks around the globe. This reduces the volatility of stock investments in this industry in the long run. Taken together, mass vaccinations reduce the risk of investment in the tourism industry, which manifests in lower volatility of returns on the tourism industry's stocks.

Although it is easier said than done, policymakers should endeavor to increase the vaccination rate in order to attain herd immunity. In turn, a higher vaccination rate will translate into a faster recovery of the economy and the tourism industry. Specifically, such policy efforts will eliminate demand shocks due to COVID-19 itself and restrictions; and, in turn, boost tourism demand. Managers of travel and leisure companies should also keep abreast of vaccination policies to meet the possible rising demand for travel and leisure. However, it is worth mentioning that the complexity of such a recovery should not be underestimated in light of the multidimensional uncertainty brought by the COVID-19 pandemic (Zenker and Kock 2020).

One indirect implication of the critical discussion of a tourism research agenda in the post-pandemic era in Zenker and Kock (2020) is that the valuation models of the tourism industry's recovery should cater to these five points: (i) a change in destination image driven by the COVID-19 pandemic; (ii) a change in tourist behavior; (iii) a change in the host country's behavior; (iv) a change in the tourism industry; and (v) the long-term and indirect costs created by the COVID-19 pandemic. Our results indicate that mass vaccinations appear to resolve this multidimensional uncertainty partially. It is worth noting that the rollout of COVID-19 vaccines is associated with a larger volatility decline in emerging market countries. Lower volatility can attract international capital flows, which can be of paramount importance for their business cycle recovery. Lower volatility can also translate into a lower cost of capital. The lower cost of capital, in turn, implies that more investment projects in the travel and leisure industry will break even, which will attract more investors. The travel and leisure industry contributes more to the gross domestic product in less developed countries with favorable climate conditions, where tourism often constitutes a primary source of foreign exchange and income than in more developed countries (Rosselló et al. 2017).

Furthermore, despite the growing anti-globalization sentiment around the globe, there are sound arguments as to why the world economy should be steered towards an even higher degree of globalization, of which international tourism is an important component. Although Contractor (2021) envisages higher perceived risks in the post-pandemic world, such risks can be ameliorated by a number of factors. These include (a) more sophisticated information systems used among international trade parties; (b) closer relationships between parties involved in an international transaction; (c) marginal increase in the diversification of input and assembly-point sources; (d) a decrease in a multidimensional "distance" between countries, in which parties to the international transaction are located; and (e) the quest for common standards in international trade. To the extent to which information about vaccination rates is perceived by investors to mediate the effects of these factors, the volatility of returns on travel and leisure industry stocks may decline.

5. Conclusions

In this study, we explored the effect of vaccination programs on the stock market volatility of the travel and leisure sector. By using daily data from 56 countries over the period from January 2020 to March 2021, we documented that vaccination decreases the investment risk of travel and leisure companies. There is a drop in volatility. Our finding is robust to many alternative estimation techniques, alternative volatility measures, additional control variables, and time periods, and does not depend on either the pandemic or government policy responses. Furthermore, the impact of mass vaccinations on the risk of tourism companies is more substantial in emerging markets.

The main limitation of this study lies in the nature of the dataset, which is fresh and relatively short. Spreading vaccination to more countries would yield more extensive and richer datasets, allowing us to re-evaluate and verify our findings. Future studies can compare the impact vaccinations have on the return and volatility of different industries. They can also consider alternative risk measures, such as default probability, systemic risk, or value at risk. Future research could disentangle "good volatility" (i.e., positive semi-variance) from "bad volatility" (i.e., negative semi-variance). In this regard, Patton and Sheppard (2015) find that future volatility is more strongly linked to the volatility of past negative returns ("bad volatility") than the volatility of past positive returns. Thus, it would be interesting to ascertain how the balance between "good volatility" and "bad volatility" has changed since the rollout of mass vaccinations around the globe. Moreover, researchers can explore how vaccination affects other asset classes, such as corporate bonds and the credit of travel and leisure companies.

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Conflicts of Interest: The authors declare no conflict of interest.

Notes

1. The Financial Times, https://www.ft.com/content/f3413c8a-2d59-4a75-befd-ee73cd45fd80#post-9c108ebe-9a4f-4c8c-8171-5bdcb32489fb, accessed on 17 April 2020.
2. For more details, please visit https://covid19datahub.io (accessed on 17 April 2020).
3. Importantly, though official data from China is unavailable at the time of writing of this paper, rough estimations can be made based on press reports. For robustness, in an unreported analysis, we replicate our analyses with these data included. Accounting for China does not measurably affect our findings.
4. The data was collected in April 2021.
5. https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html (accessed on17 April 2020).
6. When using Log (TV), we do not include Log (MV) and Turnover to our regression to avoid multicollinearity.

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