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ORIGINAL ARTICLE OPEN ACCESS

Impact of COVID-19 Vaccinations on the UK Stock Market

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Received: 27 January 2025 | **Revised:** 16 July 2025 | **Accepted:** 18 July 2025

Keywords: covid-19 | stock returns | vaccinations

ABSTRACT

This study sheds light on the interaction between COVID-19 vaccinations and economic recovery from the pandemic crisis. Using London Stock Exchange data (Jan 10, 2021, to Feb 24, 2022) and fixed-effects regression methods, this study assesses COVID-19 vaccine effects on UK stock returns. Initial protocol doses have a strong positive impact on returns, while boosters have a modest positive impact. A logarithmic unit increase in daily vaccine doses corresponds to a 0.07 percentage point increase in daily stock return. Stringent closure policies strengthen the positive influence of the vaccine on returns. Sector-wise, healthcare responds most positively, while basic resources and food/beverage industries show positive but muted effects.

JEL Classification: E65, G12, I18

1 | Introduction

The outbreak of COVID-19, first identified in Wuhan, China in December 2019, quickly escalated into a global pandemic, infecting close to 700 million people and leading to the deaths of nearly 7 million individuals.[1] As the virus spread across continents, governments worldwide were forced to enact strict measures to halt its transmission. In the United Kingdom, the first nationwide lockdown was announced on March 23, 2020, leading to the closure of all non-essential shops and public places.

To allow for a return to normality, vaccines against COVID-19 were developed and approved at an incredibly rapid pace. By the end of 2020, several pharmaceutical companies announced the successful development of a vaccine. We study how vaccine rollout affected stock prices. In particular we ask, whether an increase in daily vaccinations increased stock market returns, whether the effect was different for initial doses and booster doses, whether lockdowns mitigated or amplified the positive effect of vaccine rollout on stock returns, and whether specific industries were affected more by the COVID-19 vaccine rollout. To the best of our knowledge, this is the first study to empirically address these questions.

We study stock market returns in the United Kingdom. The UK was among the first countries to approve and distribute COVID-19 vaccines, providing the longest available period to assess the impact of vaccines on the stock market. The UK government's pandemic response offers a setting to investigate the relationship between closure policies and vaccinations. A study tailored to the UK can equip its investors with critical insights, preparing them for decision-making during similar public health events in the future. Furthermore, as a leading global financial center, the UK's market findings can offer valuable perspectives for other major markets worldwide.

We collect the daily data on stock market returns of all 2616 companies listed on the London Stock Exchange, from January 10, 2021 (when vaccination rollout data starts) to February 24, 2022 (when the last lockdown restrictions were lifted). Our variables of interest are different indicators of the COVID-19 vaccine rollout. We complement the data with stock-specific control variables, and other pandemic-related indicators, to analyze the relationship between the administration of the COVID-19 vaccine and stock returns in the UK. The fixed effects models are employed for analysis.

Our results show that increases in daily COVID-19 vaccinations are associated with statistically and economically significant increases in UK stock returns. Specifically, we report four findings. First, a logarithmic unit increase in the daily new vaccine doses (a 2.72-fold increase in vaccine doses) corresponds to an average increase of 0.07% points in daily returns. It is nearly 10 times larger than the average daily return of 0.009% over the sample period, and thus represents a substantial movement in financial terms. Second, the effect is more pronounced for the initial protocol of vaccination with a coefficient of 0.096, compared to the booster dose with a coefficient of 0.0045. Third, while closure policies alone have a negative effect on stock market performance, the positive impact of vaccines becomes stronger when such stringent measures are in place. Fourth, vaccination has a positive impact across all industries but exerts a stronger effect on the healthcare industry and a weaker effect on the basic resources, and food beverage and tobacco industries.

2 | Literature Review

2.1 | The Impact of the COVID-19 Vaccines on Financial Markets

Even before the public vaccination began, global stock markets conveyed crucial information about market expectations regarding the economic value of COVID-19 vaccine development. Chan et al. (2022) conduct panel regressions and construct dummy variables that took the value of one on the first day of any phase of clinical trials and 0 otherwise. They find that stock market returns worldwide respond positively when various COVID-19 vaccines begin different stages of human clinical trials, especially when phase III trials commence. Kucher et al. (2023) analyze how the 140 announcements about vaccine development between January and December 2020 affected stock prices, expectations of future monetary policy, and commodity prices in international markets. They show that markets that experienced larger declines at the beginning of the pandemic have a larger positive response to good vaccine news than markets that experienced smaller initial declines.

Using an event study approach Ho et al. (2022) examine the reaction of the Chinese stock market to COVID-19 vaccine approval announcements, finding that the Chinese stock market responds positively to COVID-19 vaccine approval announcements. Industries such as manufacturing, wholesale and retail, and information technology consistently benefited, while sectors such as transportation and hotels and catering only responded positively to the initial vaccine approval announcements, suggesting no immediate signs of recovery for these sectors. During the clinical trial phase, announcements of progression to the next phase and vaccine approval significantly impacted the market, with the most pronounced effect occurring immediately. Thus, the event study methodology is suitable for such scenarios. However, subsequent vaccine roll-out is a more extended process. The event study can only capture short-term effects, necessitating a different approach to understanding the longer-term relationship between the vaccine and stock market performance.

The beneficial role of vaccine distribution on stock market stability has been confirmed in Rouatbi et al. (2021). Using panel data analysis, they discover that the stabilizing effect of COVID-19 vaccination on market volatility is more pronounced in developed markets.

Vaccination also has a positive effect on stock market returns. Jeremiah et al. (2023) employ the Feasible Generalized Least Squares (FGLS) approach to analyze the effect of the Vaccine Dose Trend (VDT) on healthcare stock indices in Southeast Asia, uncovering a positive relationship. However, this positive effect might not be universally applicable, as research suggests that the impact of vaccines on stock market returns varies across countries.

Motivated by these studies, we focus on a single, developed economy with a large financial sector and employ panel regressions to assess the impact of COVID-19 vaccine rollout on stock market performance. To the best of our knowledge, ours is the first study to quantify the impact of different doses on stock returns and quantify the different effects across various industries.

2.2 | The Impact of the COVID-19 Pandemic on Financial Markets

Ashraf (2020a) find that an increase in confirmed cases leads to a decrease in stock returns in the short term. Topcu and Gulal (2020) find that emerging markets are more adversely affected than developed ones. Meanwhile, Zhang et al. (2020) find that an increase in confirmed cases also leads to an increase in the volatility of the market. This is due to the significant risk and uncertainty that the pandemic brings to the global financial market.

The relationship between the number of deaths and stock returns is more complex. In the US market, an increase in deaths decreases the stock returns (Albulescu 2021; Baig et al. 2021). However, Ashraf (2020a), conducting panel regression on the data of deaths and stock returns in 64 countries, finds that the response of stock returns to death cases is not significant. This is because death cases can be roughly predicted by the confirmed cases, so the market has already responded to the death cases when it learns about the number of confirmed COVID-19 cases.

It is also indicated that there is a heterogeneous reaction toward different sectors within the stock market. Al-Awadhi et al. (2020) find that during the COVID-19 period, the returns in the medicine manufacturing industry were higher than the overall market, while the returns in the beverage and transportation industries were lower.

Motivated by these studies, we observe that COVID-19 cases (and deaths) had heterogeneous effects across different industries. Therefore, we study and confirm that COVID-19 vaccines also exhibit heterogeneous effects across industries.

2.3 | The Impact of Government COVID-19 Interventions on the Stock Market

The impact of closure policies on stock markets continues to be a subject of debate. Some studies show that the impact is negative in returns, liquidity, and volatility Baig et al. (2021), Baker et al. (2020). Ashraf (2020b) suggests that while closure policies have an overall negative impact on stock returns, they also indirectly produce a positive effect by reducing COVID-19 cases. Conversely, some studies suggest that lockdowns have a positive impact on returns Narayan et al. (2021) and lead to a decrease in market liquidity Zaremba et al. (2021).

Income support policies contribute positively to market returns in the short term, playing a crucial role in offsetting the impact of the pandemic Ashraf (2020b), Gormsen and Koijen (2020), Topcu and Gulal (2020). However, the long-term effects of the income support policies are uncertain Zhang et al. (2020).

Motivated by these studies, we include a measure of stringency in our empirical setup and show that lockdowns had mitigating effects on the relationship between COVID-19 vaccines and stock market returns.

3 | Methodology and Data

This study aims to investigate the influence of COVID-19 vaccine administration on companies listed on the London Stock Exchange (LSE), focusing on the overall market impact, the potential modulation of this relationship by factors such as lockdowns and vaccination rates, and the differential effects across various sectors.

To address these research objectives, this section introduces the analytical strategy employed. As a benchmark, we estimate empirical model in Equation (1):

$$Return_{i,t} = \alpha_0 + \beta Vac_{t-1} + \theta Controls_{i,t-1} + \mu_i + \epsilon_{i,t} \tag{1}$$

where $Return_{i,t}$ represents the stock return of company i at day t in percent, Vac_{t-1} is a column vector of vaccine-related variables at day $t-1$, which are the key variables. Vaccine-related data are typically reported on the following day. Therefore, it is assumed that stock prices can only respond to the vaccination situation of the previous day. $Controls_{i,t-1}$ is a column vector of control variables for company i at day $t-1$, including the logarithm of daily market capitalization and price-to-book ratio. μ_i is the company-specific factor, capturing those factors that change over companies, and $\epsilon_{i,t}$ is the error term, which is uncorrelated with Vac_{t-1} and $Controls_{i,t-1}$. To investigate whether the impact of daily new vaccine doses on stock returns varies with other factors such as lockdowns, in some specifications we also introduce interaction terms in the model.

Next, a panel model needs to be selected to deal with μ_i. Since the coefficients of independent variables are assumed to be constant and not vary with company changes, fixed effects and random effects models are considered. Several tests are used to determine whether to use a fixed-effects model or a random-effects model, including the *F*-test, the BP-LM test, and the Hausman test.[2]

3.1 | Data and Sources

This study uses vaccination data from the United Kingdom, including the number of daily new doses, total booster doses, and people fully vaccinated. The data are sourced from Our World in Data.[3] The study spans from January 10, 2021, when the vaccination data began, to February 24, 2022, when the UK officially lifted all administrative restrictions,[4] marking a pivotal return to normalcy. We calculate daily new booster doses as the difference between the numbers of total boosters on two consecutive days. We calculate daily new initial protocol doses as the difference between the daily new vaccine doses administered and daily new booster doses.

Concurrently, the study incorporates four economy-level control variables at daily frequency: the S&P500 index,[5] the Official Bank Rate published by the Bank of England,[6] the Consumer Price Inflation published by the UK Office for National Statistics,[7] and the Oxford COVID-19 Government Response Tracker,[8] gathered from the University of Oxford, which encapsulates information about the pandemic response measures enacted by governments. We use stringency, which reflects, as a number between 0 and 100, the degree of the government response in terms of containment and closure policies, along with public information campaigns.

The study utilizes company-level data incorporating three variables at daily frequency: stock returns, daily market capitalization, and price-to-book ratio, collected from Bloomberg. The daily market capitalization is selected as a control variable according to Al-Awadhi et al. (2020), calculated as in Equation (2):

$$\begin{aligned} MarketCap_{i,t} = \text{Closing stock price}_{i,t} \\ \times \text{Outstanding shares}_{i,t} \end{aligned} \tag{2}$$

where Closing stock $\text{price}_{i,t}$ is the final trading price of stock i at the end of day t, and Outstanding $\text{shares}_{i,t}$ is the total number of shares that company i has issued and are in circulation in the market at day t. The price-to-book ratio is chosen following Al-Awadhi et al. (2020) and calculated by Equation (3):

$$PBRatio_{i,t} = \frac{\text{Market price per share}_{i,t}}{\text{Book value per share}_{i,t}} \tag{3}$$

where Market price per $\text{share}_{i,t}$ is the current price of a single share of stock in the company i in the open market at day t, and Book value per $\text{share}_{i,t}$ is calculated by taking the total book value of company i (total assets minus total liabilities) and dividing it by the number of outstanding shares at day t.

Stock returns are set as a dependent variable, with daily market capitalization and price-to-book ratio serving as control variables. The sample in this study is not restricted to companies included in specific sectors. Instead, it uses all 2616 stocks traded on the London Stock Exchange from January 10, 2021 up to February 24, 2022. This approach allows for the inclusion of smaller-scale companies, thereby providing a comprehensive evaluation of the influence of vaccination on the stock market.

This study also uses several dummy variables to classify companies into different industries based on the Industry Classification Benchmark (ICB) released by FTSE Russell in 2019. This classification system categorizes industries into four levels: Industry, Supersector, Sector, and Subsector. For this study, the following supersectors are selected: healthcare, financial services, travel and leisure, basic resources, food, beverage and tobacco, and real estate. Within healthcare and basic resources, the selection is further narrowed down to the following sectors: healthcare providers, medical equipment and services, pharmaceuticals and biotechnology, industrial materials, industrial metals and mining, and precious metals and mining.

3.2 | Summary Statistics

This study applies a logarithmic transformation to the daily new vaccine doses, new initial protocol doses, new booster doses, and market capitalization to normalize the magnitudes of these variables. This approach reduces the influence of absolute scale differences between variables.

Upon inspection of data, some extreme values were identified in stock returns and price-to-book value. Some were identified as data entry errors and were removed directly from the dataset, while others were influenced by corporate financing, mergers, and other activities. The approach of trimming the data at the 1st and 99th percentiles is used to remove these extreme values. After processing the data, a total of 719,237 stock returns observations, 628,760 daily market capitalization observations, and 388,552 price-to-book ratio observations not null are obtained. The software used in this study is Stata MP 17 (64-bit). Table A1 in the Appendix provides a list of the variables employed in our analysis.

Figure 1 shows the cumulative average daily returns in the UK. The figure illustrates that the overall stock returns in the London Stock Exchange from the selected period exhibited an upward trend followed by a downward trend. It sees a rapid increase during the first half of 2021, subsequently entering a phase of volatility fluctuating around 10%. By the end of 2021, it begins a downward trend marked by fluctuations.

Figure 2 shows the overall vaccine doses administered in the UK, including both initial and booster shots. The figure reveals two major surges in the total vaccination count. The first surge corresponds to the initial rollout of the vaccine, while the second one is observed in January 2021. Examining the individual curves for initial and booster vaccinations, it becomes clear that the first upswing is driven by the administration of initial doses. The second surge can largely be attributed to the increased administration of booster shots, as the number of initial doses began to plateau from July 2021 onwards.

Combining the insights from Figures 1 and 2, it is observed that during the phase of rapid growth in vaccine doses, the accelerated pace of vaccinations aligns with the upward trend of cumulative stock returns, suggesting a positive relationship. However, in the second phase when the administered vaccines mainly consist of booster doses, the relationship appears to be negatively correlated. This implies that the relationship between vaccination and stock market returns is multifaceted and

FIGURE 1 | Cumulative average daily returns in the UK (Jan 2021–Feb 2022). This figure displays the cumulative average daily stock returns in the London stock exchange during the period from January 10, 2021, to February 24, 2022. Data on stock returns were obtained from Bloomberg.

requires a more in-depth analysis, which this paper provides in the next section.

Table 1 presents the summary statistics of the data included. It can be seen that the average stock returns during this period are positive, with a maximum value of 9.27% and a minimum of −7.99%. Moreover, the data show leptokurtic and positively skewed distribution, a common feature observed in stock market data.

Table A2 in the Appendix shows the correlations among all variables. Within the core variables, there is a positive correlation, although small in absolute terms, between stock returns and vaccination. Observing the correlation coefficients between the independent variables, it was found that the correlations are small in absolute values, so we conclude that there is no problem of multicollinearity.

We examined the data stationarity using the Fisher-Type Augmented Dickey-Fuller (ADF) unit root test, as our dataset contains gaps (i.e., data for weekends are unavailable in the stock market). The Fisher-type is suitable for datasets with gaps in individual series, and it does not require a balanced panel (Choi 2001). The results represented in Table A3 in the Appendix indicate that Return, Log New Vaccines, Log Initial Doses, Log Booster Doses and Inflation are stationary at levels, and the remaining variables are stationary at first differences. Therefore, we have transformed Log Market Cap, PB Ratio, Stringency, SP500 and Interest Rate into the first difference form so that all variables are stationary and suitable for further analysis.

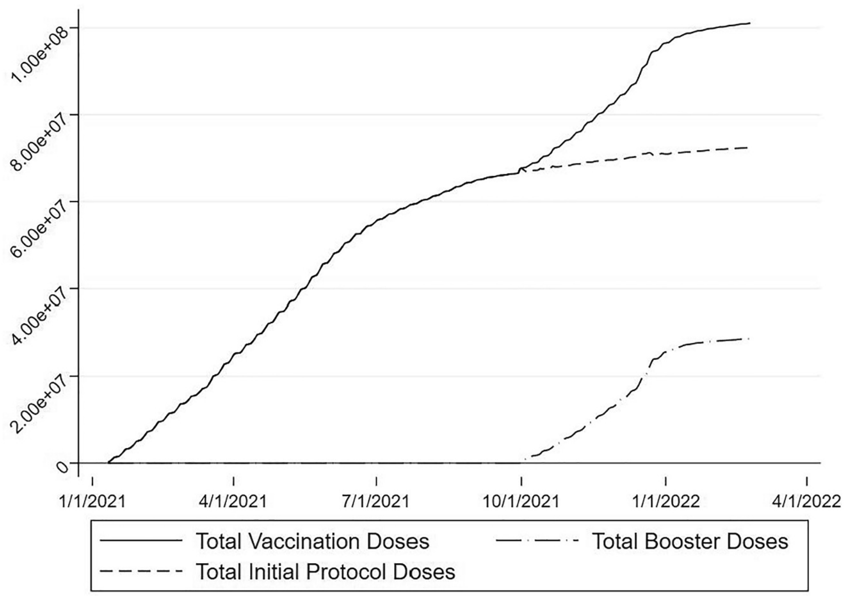

FIGURE 2 | Total vaccine doses administered in the UK (Jan 2021–Feb 2022). This figure shows the total vaccine doses administered in the UK, including both initial and booster doses. The data were sourced from our world in data, covering the period from January 10, 2021, to February 24, 2022.

TABLE 1 | Summary statistics.

Variable	Mean	Median	SD	Min	Max	Skewness	Kurtosis
Return	0.009	0.00	2.30	−7.99	9.27	0.39	7.74
Log market cap	4.29	4.56	2.91	−9.21	11.97	−0.68	4.29
PB ratio	4.26	1.73	8.60	0.13	67.56	5.45	36.97
Log new vaccines	12.54	12.73	0.70	10.74	13.88	−0.71	2.71
Log initial doses	11.99	12.21	1.00	9.93	13.52	−0.15	1.57
Log booster doses	4.36	0	5.84	0	13.79	0.61	1.42
Stringency	54.39	43.98	17.21	29.05	87.96	0.88	2.45
SP500	4313.72	4358.41	277.56	3714.24	4796.56	−0.33	2.13
Interest rate	0.14	0.10	0.10	0.10	0.50	2.78	10.04
Inflation	112.12	112.10	1.94	109.30	115.40	0.15	1.75

Note: Return is the daily stock return, Log Market Cap is the natural logarithm of daily firm market capitalization, PB Ratio is the price-to-book ratio, Log New Vaccines is the natural logarithm of new vaccine doses, Log Initial Doses is the natural logarithm of new initial protocol doses, Log Booster Doses is the natural logarithm of new booster doses, Stringency is the stringency index, SP500 is the S&P500 Index, Interest Rate is the official bank rate, and Inflation is the consumer price inflation.

4 | Empirical Analysis

This section delves into the selection of the appropriate model for estimating the panel data and discusses the empirical results derived from the data.

4.1 | Model Selection

To select the appropriate model to estimate the panel data, this study conducted the *F*-test, the BP-LM test, and the Hausman test. The results are shown in Tables A5, A6, and A7 in the Appendix. For each *F*-test, the *p*-value is 0.0000, rejecting the null hypothesis that the intercept terms are the same for different cross-sectional models, which considers the fixed-effects model to be more appropriate than POLS (pooled ordinary least squares); in each LM-test, the *p*-value of 0.0000 rejects the null hypothesis that Var(u) = 0, considering the random effects model to be more appropriate than POLS. Then, the Hausman test is used to compare fixed effects and random effects models. The *p*-value of 0.0000 rejects the hypothesis that the coefficients in the random effects model are unbiased and considers the fixed-effects model to be more appropriate. In summary, the fixed effects model is chosen for regressions.

4.2 | Benchmark Results

First, the daily new vaccine doses are used to find the effect of vaccination on stock returns. We estimate regression Equation (4):

$$\begin{aligned} Return_{i,t} = \alpha_0 &+ \beta_1 LogNewVaccines_{t-1} \\ &+ \theta_1 D.LogMarketCap_{i,t-1} + \theta_2 D.PBRatio_{i,t-1} \\ &+ \theta_3 D.SP500_{t-1} + \theta_4 D.InterestRate_{t-1} \\ &+ \theta_5 Inflation_{t-1} + \eta_{i,t} \end{aligned} \quad (4)$$

where $Return_{i,t}$ represents the stock return of company i at day t, $LogNewVaccines_{t-1}$ is the logarithm of daily new vaccine doses at day $t-1$, $D.LogMarketCap_{i,t-1}$ denotes the logarithmic difference of the daily market capitalization of company i at day $t-1$, $D.PBRatio_{i,t-1}$ stands for the difference of price-to-book ratio of company i at day $t-1$, $D.SP500_{t-1}$ reflects the difference of S&P500 Index at day $t-1$, $D.InterestRate_{t-1}$ refers to the difference of official bank rate at day $t-1$, $Inflation_{t-1}$ indicates the consumer price inflation at day $t-1$, and $\eta_{i,t}$ is the error term.

Table 2 reports the results. The effect of the vaccine doses is always positive and stable across different specifications. A unit increase in the logarithm of vaccine doses causes an increase of between 0.065p.p and 0.110p.p. in stock returns, with all the estimators statistically significant except D. PB Ratio.

In addition to statistical significance, the effect of vaccination is economically meaningful. The coefficient estimate of 0.07 in the model with all controls in column (7) implies that a 2.72-fold increase in daily vaccine doses (a one-unit increase in the natural logarithm) is associated with a 0.07% point increase in daily stock returns. This effect is substantial when compared to the mean daily return of 0.009% and a standard deviation of 2.3% in our sample. To further illustrate, if vaccine doses doubled for five consecutive days (a cumulative log change of approximately 1.6), the predicted cumulative return increase would be about 0.112%, more than 12 times the average daily return. This

TABLE 2 | Regressions with daily new vaccine doses.

	(1)	(2)	(3)	(4)	(5)	(6)
Log new vaccines	0.0653***	0.0908***	0.1095***	0.0872***	0.0891***	0.0732***
	(0.0046)	(0.0061)	(0.0085)	(0.0087)	(0.0087)	(0.0087)
D.Log market cap		−0.4882***	−1.9884***	−2.0285***	−2.0289***	−2.0318***
		(0.1140)	(0.3538)	(0.3565)	(0.3564)	(0.3562)
D.PB ratio			0.0042	0.0017	0.0016	0.0017
			(0.0130)	(0.0132)	(0.0132)	(0.0132)
D.SP500				0.0051***	0.0053***	0.0054***
				(0.0002)	(0.0002)	(0.0002)
D.IR					1.4890***	1.6981***
					(0.2527)	(0.2559)
Inflation						−0.0160***
						(0.0034)
α_0	−0.8007***	−1.1323***	−1.3606***	−1.0666***	−1.0938***	0.8968**
	(0.0558)	(0.0773)	(0.1076)	(0.1096)	(0.1094)	(0.4179)
Observations	575,011	376,066	202,864	193,586	193,586	193,586

Note: Table shows regression coefficients estimates. The dependent variable is the daily stock return *R*, among the independent variables: Log New Vaccines is the natural logarithm of new vaccine doses, D.Log Market Cap is the logarithmic difference of daily firm market capitalization, D.PB Ratio is the difference of price-to-book ratio, D. SP500 is the difference of S&P500 Index, D.Interest Rate is the difference of official bank rate, and Inflation is the consumer price inflation. Robust standard errors are in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

highlights that the observed response is not only statistically significant but also economically meaningful.

4.3 | Initial Protocol and Booster Doses

Next, to explore whether different stages of vaccination affect stock market returns to different extents, we split the vaccine doses into initial protocol doses and booster doses. The regression model is specified as in Equation (5):

$$
\begin{aligned}
Return_{i,t} = \alpha_0 &+ \beta_1 LogInitialDoses_{t-1} + \beta_2 LogBoosterDoses_{t-1} \\
&+ \theta_1 LogMarketCap_{i,t-1} + \theta_2 D.PBRatio_{i,t-1} \\
&+ \theta_3 D.SP500_{t-1} + \theta_4 D.InterestRate_{t-1} \\
&+ \theta_5 Inflation_{t-1} + \eta_{i,t}
\end{aligned} \tag{5}
$$

where $LogInitialDoses_{t-1}$ is the logarithm of daily new initial protocol doses, and $LogBoosterDoses_{t-1}$ denotes the logarithm of daily new booster doses.

Table 3 shows the results of regressions with the new initial protocol and booster doses. The coefficients for both doses are consistently positive. However, the effect of the initial protocol dose is markedly higher than the effect of the booster dose. A 1% increase in the logarithm of the initial protocol doses is associated with a 0.07–0.13p.p. increase in stock market returns, while a 1% increase in the logarithm of the booster doses is associated with an approximate 0.002–0.007p.p. increase in returns.

4.4 | Lockdown Stringency

Next, we study whether the effects work differently depending on the overall pandemic situation. The difference of stringency index in D. Stringency is used to stand for the severity of closure policies. We interact this variable with the logarithmic difference of daily new vaccines. The regression is estimated as in Equation (6):

$$
\begin{aligned}
Return_{i,t} = \alpha_0 &+ \beta_1 LogNewVaccines_{t-1} + \beta_2 D.Stringency_{t-1} \\
&+ \beta_3 LogNewVaccines_{t-1} \times D.Stringency_{t-1} \\
&+ \theta_1 D.LogMarketCap_{i,t-1} + \theta_2 D.PBRatio_{i,t-1} \\
&+ \theta_3 D.SP500_{t-1} + \theta_4 D.IR_{t-1} + \theta_5 Inflation_{t-1} \\
&+ \eta_{i,t}
\end{aligned} \tag{6}
$$

where $D.Stringency_{t-1}$ is the difference of stringency index in the Oxford COVID-19 Government Response Tracker, and $LogNewVaccines_{t-1} \times D.Stringency_{t-1}$ is the interaction term of the natural logarithm of daily new vaccine doses and the difference of stringency index.

Table 4 presents the results of the regressions considering the stringency index. The first model includes the measure of lockdown stringency. We find that when included alone, the effect of lockdown stringency on stock returns is, perhaps somewhat surprisingly, positive and statistically significant. In the second model however, where we include an interaction term between vaccine doses and lockdown stringency, the coefficient on stringency becomes negative and the interaction

TABLE 3 | Regressions with new initial protocol and booster doses.

	(1)	(2)	(3)	(4)	(5)	(6)
Log initial doses	0.0781***	0.0992***	0.1241***	0.0931***	0.0951***	0.1321***
	(0.0055)	(0.0073)	(0.0107)	(0.0109)	(0.0109)	(0.0137)
Log booster doses	0.0056***	0.0060***	0.0072***	0.0058***	0.0052***	0.0018
	(0.0008)	(0.0011)	(0.0016)	(0.0016)	(0.0016)	(0.0018)
D.Log market cap		−0.4895***	−1.9964***	−2.0375***	−2.0384***	−2.0381***
		(0.1140)	(0.3535)	(0.3564)	(0.3562)	(0.3560)
D.PB ratio			0.0044	0.0017	0.0017	0.0017
			(0.0130)	(0.0132)	(0.0132)	(0.0132)
D.SP500				0.0052***	0.0055***	0.0055***
				(0.0002)	(0.0002)	(0.0002)
D.Interest rate					1.7382***	1.6388***
					(0.2554)	(0.2557)
Inflation						0.0306***
						(0.0077)
α_0	−0.9410***	−1.2068***	−1.5052***	−1.1122***	−1.1387***	−4.9964***
	(0.0685)	(0.0915)	(0.1344)	(0.1370)	(0.1370)	(0.9669)
Observations	575,011	376,066	202,833	193,586	193,586	193,586

Note: Table shows regression coefficients estimates. The dependent variable is the daily stock return R, among the independent variables: Log Initial Doses is the natural logarithm of daily new initial protocol doses, and Log Booster Doses is the natural logarithm of daily new booster doses, D.Log Market Cap is the logarithmic difference of daily firm market capitalization, D.PB Ratio is the difference of price-to-book ratio, D.SP500 is the difference of S&P500 Index, D.Interest Rate is the difference of official bank rate, and Inflation is the consumer price inflation, Robust standard errors are in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

TABLE 4 | Regressions with lockdown stringency.

	(1)	(2)
Log new vaccines	0.0684***	0.0733***
	(0.0087)	(0.0089)
D.Stringency	0.0565***	−0.4419***
	(0.0092)	(0.1528)
Log new Vaccines*D.Stringency		0.0425***
		(0.0131)
D.Log market cap	−2.0284***	−2.0366***
	(0.3560)	(0.3563)
D.PB ratio	0.0017	0.0017
	(0.0132)	(0.0132)
D.SP500	0.0055***	0.0055***
	(0.0002)	(0.0002)
D.Interest rate	1.6748***	1.6755***
	(0.2559)	(0.2559)
Inflation	−0.0127***	−0.0117***
	(0.0035)	(0.0035)
α_0	0.5971	0.4183
	(0.4231)	(0.4295)
Observations	193,586	193,586

Note: Table shows regression coefficients estimates. The dependent variable is the daily stock return *R*, among the independent variables: Log New Vaccines is the natural logarithm of new vaccine doses, D.Stringency is the difference of stringency index in the Oxford COVID-19 Government Response Tracker, D.Log Market Cap is the logarithmic difference of daily firm market capitalization, D. PB Ratio is the difference of price-to-book ratio, D.SP500 is the difference of S&P500 Index, D.Interest Rate is the difference of official bank rate, and Inflation is the consumer price inflation.Robust standard errors are in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

term is positive and statistically significant. This specification allows for a clearer interpretation. Stricter lockdowns tend to depress stock returns, reflecting the adverse economic impact of containment measures. However, the positive interaction implies that the market responds favorably to vaccine progress during periods of heightened restrictions. One interpretation is that vaccination campaigns under strict lockdowns send a stronger signal to investors about the prospect of a return to normalcy, thereby mitigating the negative effects of lockdown policies. Returning to the first model, the positive coefficient on lockdown stringency likely reflects a combination of these opposing effects. Without explicitly modeling the interaction, the estimate is biased and difficult to interpret.

Quantitatively, the results can be interpreted in the following way. A unit increase in the natural logarithm of vaccine doses corresponds to roughly a 2.72x increase in the number of vaccine doses. If lockdown conditions remain unchanged, this increase is associated with a 0.07% point rise in daily stock returns. However, if lockdown stringency also rises by one point on the 0–100 scale, the total effect becomes a net 0.40% point decline, composed of a −0.44pp direct effect from the lockdown and a +0.04pp mitigating effect from the enhanced value of vaccination under tighter restrictions. This dynamic suggests that market participants reward vaccine progress more when restrictions remain high, possibly because it signals a faster pathway to reopening.

4.5 | Industry and Sector Analysis

To discuss whether the influence of vaccines is different across industries and sectors, we first add dummy variables for the supersector (industry) and then dummy variables for selected sectors, together with their interactions with the vaccine variable. The estimated regression in Equation (7) accounts for the different effects of vaccinations in various supersectors:

$$\begin{aligned} Return_{i,t} = \alpha_0 + \beta_1 LogNewVaccines_{t-1} + \beta_2 LogNewVaccines_{t-1} \\ \times SS_{i,j} + \alpha_1 D.LogMarketCap_{i,t-1} + \alpha_2 D.PBRatio_{i,t-1} \\ + \alpha_3 D.SP500_{i,t-1} + \alpha_4 D.InterestRate_{i,t-1} \\ + \alpha_5 Inflation_{i,t-1} + \eta_{i,t} \end{aligned} \quad (7)$$

where $SS_{i,j}$ are the dummy variables representing firms in eight different supersectors (industries): Healthcare; Basic Resources; Food Beverage and Tobacco; Financial Services; Travel and Leisure; Retail; Telecommunication; and Real Estate.

Table 5 displays the results of the regression with supersector dummy variables. By interpreting the sign and magnitude of the interaction coefficient, we can establish whether vaccinations have a greater or lesser impact on firms in a particular supersector compared to the average. The interaction coefficient in the Healthcare industry is positive and statistically significant, indicating that daily new vaccine doses have an additional 0.06p.p. positive effect on the return of stocks in the Healthcare industry compared to stocks in other industries. A unit increase in the logarithm of vaccine doses is associated with a 0.13p.p. Total increase in the Healthcare industry's stock returns. The interaction coefficient in Basic Resources is negative and statistically significant, suggesting that the positive effect of vaccine doses on the Basic Resources industry is weaker compared to other industries. The overall effect of vaccine doses on the Basic Resources industry is negative: a unit increase in *LogNewVaccines* is associated with a 0.02p.p. Decrease in market returns of the Basic Resources industry. Similarly, the interaction coefficient is negative in the Food Beverage and Tobacco supersector, but the combined effect remains positive, resulting in an overall increase of 0.2p.p. in market returns. The interaction coefficient is negative in Real Estate and positive in Financial Services, Travel and Leisure, Retail and Telecommunications; however, these effects are not statistically significant, so these results should be interpreted with caution.

The muted or negative responses of Basic Resources and Food, Beverage and Tobacco sectors may reflect the essential nature and inelastic demand of their goods. These sectors likely experienced less disruption during lockdowns and, correspondingly, less benefit from reopening optimism triggered by vaccine rollout. For example, demand for basic materials and food items remained stable even under restrictions, leading to a smaller market revaluation upon vaccine progress.

TABLE 5 | Regressions with supersector dummy variable interaction terms.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log new vaccines	0.0684***	0.0828***	0.0748***	0.0727***	0.0709***	0.0712***	0.0725***	0.0742***
	(0.0090)	(0.0091)	(0.0089)	(0.0095)	(0.0090)	(0.0089)	(0.0089)	(0.0091)
Log new vaccines	0.0572*							
*HEALTHC.	(0.0346)							
Log new vaccines		−0.1000***						
*BASIC RES.		(0.0325)						
Log new vaccines			−0.0652*					
*FOOD BEV. TBCC.			(0.0357)					
Log new vaccines				0.0022				
*FINANCIAL SERV.				(0.0225)				
Log new vaccines					0.0435			
*TRAVEL LEIS.					(0.0390)			
Log new vaccines						0.0630		
*RETAIL						(0.0411)		
Log new vaccines							0.0289	
*TELECOM.							(0.0626)	
Log new vaccines								−0.0210
*REAL ESTATE								(0.0176)
D.Log market cap	−2.0371***	−2.0408***	−2.0368***	−2.0366***	−2.0365***	−2.0366***	−2.0363***	−2.0365***
	(0.3566)	(0.3566)	(0.3566)	(0.3566)	(0.3566)	(0.3566)	(0.3565)	(0.3566)
D.PB ratio	0.0017	0.0017	0.0016	0.0017	0.0017	0.0017	0.0016	0.0017
	(0.0132)	(0.0132)	(0.0132)	(0.0132)	(0.0132)	(0.0132)	(0.0132)	(0.0132)
D.SP500	0.0054***	0.0054***	0.0054***	0.0054***	0.0054***	0.0054***	0.0054***	0.0054***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
D.Interest rate	1.6841***	1.6839***	1.6839***	1.6838***	1.6838***	1.6829***	1.6836***	1.6845***
	(0.2561)	(0.2561)	(0.2561)	(0.2561)	(0.2561)	(0.2561)	(0.2560)	(0.2560)
Inflation	−0.0158***	−0.0158***	−0.0158***	−0.0158***	−0.0158***	−0.0157***	−0.0157***	−0.0158***
	(0.0034)	(0.0034)	(0.0034)	(0.0034)	(0.0034)	(0.0034)	(0.0034)	(0.0034)
α_0	0.8815**	0.8802**	0.8780**	0.8776**	0.8764**	0.8637**	0.8736	0.8896**
	(0.4186)	(0.4196)	(0.4184)	(0.4184)	(0.4187)	(0.4188)	(0.4192)	
Observations	193,250	193,250	193,250	193,250	193,250	193,250	193,250	193,250

Note: Table shows regression coefficients estimates. The dependent variable is the daily stock return R, among the independent variables: Log New Vaccines is the natural logarithm of new vaccine doses, D.Log Market Cap is the logarithmic difference of daily firm market capitalization, D.PB Ratio is the difference of price-to-book ratio, D. SP500 is the difference of S&P500 Index, D.Interest Rate is the difference of official bank rate, and Inflation is the consumer price inflation.The model includes interaction terms of the natural logarithm of daily new vaccine doses and dummy variables of healthcare, basic resources, food beverage and tobacco, financial services, travel and leisure, retail, telecommunications and real estate supersectors. Robust standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

By contrast, the Healthcare and Travel sectors are highly sensitive to pandemic dynamics. The Healthcare sector benefited directly from vaccination-related services and increased medical demand, while Travel and Airlines faced heavy restrictions early on and showed stronger rebounds as vaccines restored mobility and public confidence.

To explore how the Healthcare, Basic Resources and Travel and Leisure industries are affected by vaccinations, we further investigate the specific effects in eight sectors of these three supersectors. We estimate the regression in equation (9), substituting supersector dummy variables with dummy variables for specific sectors: three in Healthcare (Healthcare Providers, Medical Equipment and Services, Pharmaceuticals and Biotechnology), three in Basic Resources (Industrial Materials, Industrial Metals and Mining, Precious Metals and Mining) and two in Travel and Leisure.

The results of these regressions are presented in Table A4 in the Appendix. The interaction coefficients for the three sectors in the Healthcare industry are all positive, with values of 0.1193, 0.0845, and 0.0307, respectively. This indicates that all these sectors experience additional positive effects from vaccine doses compared to other sectors, aligning with the overall positive effect on the Healthcare industry. Among them, the Healthcare Providers sector exhibits the highest extra positive influence, followed by Medical Equipment and Services. However, as these effects are not statistically significant, the results should be interpreted with caution.

The excess influence of vaccinations on the returns in the Healthcare industry can be explained from the perspectives of these three sub-sectors. As the primary entities administering vaccines, healthcare providers experience a surge in patient visits, leading to increased revenues. While their staff was among the first to be vaccinated, these providers can maintain consistent operations without significant disruptions from COVID-19 outbreaks, ensuring a steady flow of services and revenues. Then, the massive vaccination campaign led to a heightened demand for medical equipment, benefiting manufacturers and suppliers. Finally, pharmaceutical and biotechnology companies that have successfully developed and received approval for their COVID-19 vaccines can achieve substantial revenues from vaccine sales.

The Industrial Metals and Mining and Precious Metals and Mining sectors receive weaker positive influences from vaccinations, consistent with the results for the Basic Resources supersector. The coefficient for the interaction term of Industrial Materials, at 0.0839, implies an additional positive impact. However, the coefficient is not statistically significant, so caution should be exercised in its interpretation.

The weaker overall impact of vaccinations in the Basic Resources industry may stem from the fact that the demand for basic resources, as well as food and beverages, is considered essential, leading to these industries experiencing a relatively milder impact during the early stages of the pandemic. While other sectors witness an immediate surge in demand post-vaccination, the demand for these industries remains stable.

The Airlines and Travel and Tourism sectors appear to benefit more prominently from vaccination progress. The coefficient for the interaction term in the Airlines industry is 0.1650 and statistically significant. For the Travel and Tourism industry, the interaction term also has a positive sign (0.0576), although it does not reach statistical significance. This likely reflects the sector's high sensitivity to mobility restrictions and public health concerns: as vaccination rates rise, public confidence and travel demand tend to recover swiftly, leading to improved market performance.

While we conducted regressions for additional subsectors such as Retail, Tourism, and Telecommunication Services, the interaction terms were not statistically significant. We interpret this as evidence that not all sectors highly affected by the COVID-19 pandemic experienced visible and immediate stock market reactions that were sector-specifically different from the overall positive effect of vaccinations that we have documented before.

4.6 | Robustness Test

To ensure the robustness of the main results, subsample analyses are conducted by splitting the full sample period (from 11 January 2021 to 24 February 2022) into two equal halves. The first subsample covers the period from 10 January 2021 to 20 August 2021, and the second spans from 21 August 2021 to 24 February 2022. The change in the interest rate variable (D.IR) is not included in the early subsample regression due to being constant over the entire period. The results are reported in Table 6.

TABLE 6 | Regressions with subsample periods.

	Early period	Late period
Log new vaccines	0.0688***	0.1107***
	(0.0247)	(0.0101)
D.Log market cap	−2.2803***	−1.9895***
	(0.4066)	(0.5188)
D.PB ratio	0.0046	−0.0163
	(0.0141)	(0.0273)
D.SP500	0.0084***	0.0035***
	(0.0003)	(0.0002)
D.Interest rate		1.2156***
		(0.2572)
Inflation	0.0054	−0.0616***
	(0.0101)	(0.0067)
α_0	−1.4130	5.6342***
	(1.2464)	(0.7413)
Observations	93,405	100,181

Note: Robust standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Re-estimating the regression model separately for these two subperiods yields consistent and statistically significant coefficients for the main explanatory variable (log vaccination doses) in both samples. The effect is notably stronger in the second subperiod compared to the first. While the coefficient in the early phase is 0.07, it rises to 0.11 in the later phase, suggesting that the positive impact of vaccination on stock returns intensified over time.

This pattern may reflect several underlying mechanisms. By the second half of the sample period, booster campaigns were well underway and vaccine coverage had broadened, possibly leading investors to revise upward their expectations for reopening and economic normalization. In contrast, the early period was characterized by more uncertainty around vaccine effectiveness and logistical rollout challenges, which could have tempered investor reactions despite early progress.

5 | Conclusions

This study systematically examines the impact of COVID-19 vaccines on stock returns in the UK, employing a panel data approach that considers vaccination stages, lockdown policies, and sector-specific dynamics. The findings show a positive relationship between daily new vaccine doses and stock returns, supporting the notion that vaccinations, by enhancing public health, stimulate economic recovery and improve expectations about future economic prospects.

This effect is economically significant: the estimated return response is nearly an order of magnitude larger than the average daily market return and suggests that vaccination rollout contributed meaningfully to market dynamics during the pandemic recovery phase.

The distinction between protocol and booster doses reveals that the market perceived the initial vaccine rollout as a stronger indicator of economic recovery and stability, with subsequent booster doses generating weaker, albeit still positive market reactions. Including the lockdown stringency measure shows that stricter containment policies reduce stock returns, but the positive effect of vaccine rollout becomes even stronger under tighter restrictions, indicating a complementary relationship between the two. Exploring industry-specific impacts shows that stock returns in the healthcare and travel and leisure industries responded more strongly to the introduction of vaccines than the rest of the market. In contrast, basic resources and the food, beverage and tobacco industries showed smaller, but still positive effects, reflecting their essential nature and stable demand during the pandemic.

Our results show that vaccine rollout had a statistically significant and positive effect on UK stock returns, and that this effect was amplified under stricter lockdown conditions. While vaccines should never be viewed as an economic policy tool, their primary purpose is to protect public health, our findings indicate that they also have important economic implications. Policymakers and market participants should be aware that vaccine deployment can influence financial markets: with the effect becoming more pronounced in the later stages of the initial rollout, but diminishing with subsequent doses.

Endnotes

[1] Data sourced from: https://www.worldometers.info/coronavirus/ on 14 August 2023.

[2] While the fixed-effects panel model may not fully capture the dynamic nature of stock market responses, it offers a tractable and feasible way to handle a large panel of daily, firm-level observations. An alternative approach would be to apply a dynamic VAR framework, but in our high-dimensional setting it would require substantial aggregation and dimensionality reduction.

[3] https://ourworldindata.org/covid-vaccinations.

[4] https://www.gov.uk/government/speeches/pm-statement-on-living-with-covid-21-february-2022.

[5] https://www.nasdaq.com/market-activity/index/spx.

[6] https://www.bankofengland.co.uk/monetary-policy/the-interest-rate-bank-rate.

[7] https://www.ons.gov.uk/economy/inflationandpriceindices/datasets/consumerpriceinflation.current.

[8] https://www.bsg.ox.ac.uk/research/covid-19-government-response-tracker.

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Appendix

TABLE A1 | Variable definitions.

Variable	Definition
Dependent variable	
Return	The daily stock return for the company i on day t
Explanatory variables	
Log new vaccines	The natural logarithm of new vaccine doses
Log initial doses	The natural logarithm of new initial protocol doses
Log booster doses	The natural logarithm of new booster doses
Company-level control variables	
Log market cap	The logarithm of market capitalization in USD
PB Ratio	The price-to-book ratio
Economy-level controls	
Stringency	Stringency index from government response tracker
SP500	The S&P500 index
Interest rate	The official bank rate
Inflation	The consumer price inflation
Industry-level controls	
HEALTHCARE	Dummy variables: Equal to 1 if company i is in a given supersector/sector, 0 otherwis e
BASIC RESOURCES	
FOOD BEVERAGE AND TOBACCO	
FINANCIAL SERVICE	
TRAVEL AND LEISURE	
RETAIL	
TELECOMMUNICATION	
REAL ESTATE	
HEALTHCARE PROVIDERS	
MED. EQUIPMENT AND SERVICES	
PHARMACEUTICALS AND BIOTECH.	
INDUSTRIAL MATERIALS	
INDUSTRIAL METALS AND MINING	
PRECIOUS METALS AND MINING	

TABLE A2 | Correlation matrix results for all variables.

	Return	Log market cap	PB ratio	Log new vaccines	Log initial doses	Log booster doses	Stringency	SP500	Interest rate	Inflation
Return	1.000									
Log market cap	0.008***	1.000								
PB ratio	−0.001	0.019***	1.000							
Log new vaccines	0.028***	0.011***	0.007**	1.000						
Log initial doses	0.032***	0.017***	0.013***	0.581***	1.000					
Log booster doses	−0.022***	−0.015***	−0.014***	−0.070***	−0.824***	1.000				
Stringency	−0.028***	−0.013***	−0.001	0.470***	0.742***	−0.587***	1.000			

(Continues)

TABLE A2 | (Continued)

	Return	Log market cap	PB ratio	Log new vaccines	Log initial doses	Log booster doses	Stringency	SP500	Interest rate	Inflation
SP500	−0.002	−0.011***	0.000	−0.250***	−0.749***	0.697***	−0.891***	1.000		
Interest rate	−0.026***	−0.019***	−0.016***	−0.504***	−0.553***	0.458***	−0.416***	0.284***	1.000	
Inflation	−0.026***	−0.017***	−0.009***	−0.386***	−0.898***	0.859***	−0.874***	0.881***	0.601***	1.000

****p* < 0.01, ***p* < 0.05, **p* < 0.1.

TABLE A3 | Panel unit root test result.

ADF-Fisher chi-square	Level	First difference
Return	1.50e + 05***	
Log market cap	4059.03	9.54e + 04***
PB ratio	2285.6382	5.53e + 04***
Log new vaccines	2.33e + 04***	
Log initial doses	1.68e + 04***	
Log booster doses	7894.67***	
Stringency	206.30	1.87e + 05***
SP500	99.0167	1.31e + 05
Interest rate	58.5345	2.05e + 05***
Inflation	6884.8137***	

Note: Log New Vaccines is the natural logarithm of new vaccine doses, Log Market Cap is the natural logarithm of daily firm market capitalization, and PB Ratio is the price-to-book ratio.
****p* < 0.01, ***p* < 0.05, **p* < 0.1.

TABLE A4 | Regressions with sector dummy variable interaction terms.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log new vaccines	0.0717***	0.0714***	0.0714***	0.0729***	0.0788***	0.0774***	0.0724***	0.0725***
	(0.0088)	(0.0087)	(0.0090)	(0.0088)	(0.0089)	(0.0088)	(0.0088)	(0.0088)
Log new vaccines	0.1193							
*HEALTH. PROV.	(0.0829)							
Log new vaccines		0.0845						
*MED. EQUIP. AND SERVICES		(0.0911)						
Log new vaccines			0.0307					
*PHARMACEUT. AND BIOTECH.			(0.0381)					
Log new vaccines				0.0839				
*IND. MATERIALS				(0.1023)				
Log new vaccines					−0.0884**			
*IND. METALS AND MINING					(0.0401)			
Log new vaccines						−0.1322**		
*PREC. METALS AND MINING						(0.0565)		
Log new vaccines							0.1650**	
*AIRLINES							(0.0801)	
Log new vaccines								0.0576
*TRAVEL AND TOURISM								(0.0565)
D.Log market cap	−2.0371***	−2.0372***	−2.0365***	−2.0317***	−2.0327***	−2.0358***	−2.0360***	−2.0363***
	(0.3566)	(0.3565)	(0.3566)	(0.3562)	(0.3562)	(0.3562)	(0.3566)	(0.3566)

(Continues)

TABLE A4 | (Continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
D.PB ratio	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017
	(0.0132)	(0.0132)	(0.0132)	(0.0132)	(0.0132)	(0.0132)	(0.0132)	(0.0132)
D.SP500	0.0054***	0.0054***	0.0054***	0.0054***	0.0054***	0.0054***	0.0054***	0.0054***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
D.Interest rate	1.6839***	1.6838***	1.6840***	1.6981***	1.6980***	1.6983***	1.6838***	1.6838***
	(0.2561)	(0.2561)	(0.2561)	(0.2559)	(0.2559)	(0.2559)	(0.2561)	(0.2561)
Inflation	−0.0158***	−0.0158***	−0.0158***	−0.0160***	−0.0160***	−0.0160***	−0.0158***	−0.0158***
	(0.0034)	(0.0034)	(0.0034)	(0.0034)	(0.0034)	(0.0034)	(0.0034)	(0.0034)
α_0	0.8792**	0.8777**	0.8792**	0.8965**	0.8967**	0.8999**	0.8772**	0.8773**
	(0.4185)	(0.4186)	(0.4185)	(0.4179)	(0.4185)	(0.4187)	(0.4186)	(0.4185)
Observations	193,250	193,250	193,250	193,250	193,250	193,250	193,250	193,250

Note: Table shows regression coefficients estimates. The dependent variable is the daily stock return *R*, among the independent variables: Log New Vaccines is the natural logarithm of new vaccine doses, D.Log Market Cap is the logarithmic difference of daily firm market capitalization, D.PB Ratio is the difference of price-to-book ratio, D. SP500 is the difference of S&P500 Index, D.Interest Rate is the difference of official bank rate, and Inflation is the consumer price inflation. The model includes interaction terms of the natural logarithm of daily new vaccine doses and dummy variables of selected sectors: healthcare providers, medical equipment and services, pharmaceuticals and biotechnology, industrial materials, industrial metals and mining, precious metals and mining sectors, airlines and travel and tourism, respectively. Robust standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

TABLE A5 | Results of *F*-test, BP-LM test and Hausman test—Tables 2 to 4.

	F Test	LM test	Hausman test
(Table 2)	1.99	609.43	304.9
	(0.0000)	(0.0000)	(0.0000)
(Table 3)	1.99	609.87	343.86
	(0.0000)	(0.0000)	(0.0000)
(Table 4)	1.99	1132.19	1252.16
	(0.0000)	(0.0000)	(0.0000)

Note: This table shows the statistic of *F*-test, BP-LM test and Hausman test for first three models. The numbers in the first column correspond to models in Tables 2 to 4. *p*-value in parentheses.

TABLE A6 | Results of *F*-test, BP-LM test and Hausman test for regression with supersector dummies.

	F Test	LM test	Hausman test
(1)	1.99	602.60	304.77
	(0.0000)	(0.0000)	(0.0000)
(2)	1.99	598.86	316.37
	(0.0000)	(0.0000)	(0.0000)
(3)	1.99	608.60	306.66
	(0.0000)	(0.0000)	(0.0000)
(4)	1.99	608.00	304.50
	(0.0000)	(0.0000)	(0.0000)
(5)	1.99	609.01	307.14
	(0.0000)	(0.0000)	(0.0000)
(6)	1.99	608.74	306.69
	(0.0000)	(0.0000)	(0.0000)

(Continues)

TABLE A6 | (Continued)

	F Test	LM test	Hausman test
(7)	1.99	608.50	307.93
	(0.0000)	(0.0000)	(0.0000)
(8)	1.99	604.39	301.98
	(0.0000)	(0.0000)	(0.0000)

Note: *p*-values in parentheses. The numbers in the first column correspond to the eight regressions in Table 5.

TABLE A7 | Results of *F*-test, BP-LM test and Hausman test for regression with sector dummies.

	F Test	LM test	Hausman test
(1)	2.00	608.83	314.08
	(0.0000)	(0.0000)	(0.0000)
(2)	1.99	606.91	305.05
	(0.0000)	(0.0000)	(0.0000)
(3)	1.99	602.95	299.89
	(0.0000)	(0.0000)	(0.0000)
(4)	1.99	609.14	311.95
	(0.0000)	(0.0000)	(0.0000)
(5)	1.99	604.62	312.02
	(0.0000)	(0.0000)	(0.0000)
(6)	1.99	602.64	309.90
	(0.0000)	(0.0000)	(0.0000)
(7)	1.99	608.42	311.65
	(0.0000)	(0.0000)	(0.0000)
(8)	1.99	609.07	310.53
	(0.0000)	(0.0000)	(0.0000)

Note: *p*-value in parentheses. The numbers in the first column correspond to the eight regressions in Table A4.