Master Thesis Summary

THE IMPACT OF COVID-19 IN DAX COMPANIES: ANALYSIS OF PERFORMANCE

AND CRISIS MANAGEMENT STRATEGIES

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Introduction

This study explores the impact of COVID-19 on different companies and industries of the DAX stock market, by analyzing the financial performance of the stocks in different stages of the pandemic. The DAX stock market consists of the 40 largest German companies listed on the regulated market of the Frankfurt Stock Exchange. Given the complexity of the analysis, two different studies have been performed. In first place, the event study method to analyze the effects of the announcement of the COVID-19 pandemic and the reaction on the stock market returns. And a second analysis, to analyze the financial stability of the DAX companies comparing pre-pandemic and pandemic period, and the subsequent recovery. An additional study is performed to analyze whether the increase in daily new cases of COVID-19 infections is correlated with the performance of the DAX stock market. And finally, the crisis strategies that the firms followed to manage the COVID-19 pandemic are analyzed from the literature review of the annual reports of DAX companies.

Literature review

The COVID-19 pandemic, which started in 2020, had a strong impact all over the world. The virus had infected by February 2022 more than 420 million people and killed almost 6 million globally. The rapid spread became disastrous for the economy. With the aim to contain the virus, the countries started to impose strict lockdowns that paralyzed the economic activity and forced many companies to close. Production, supply chains, international trade and tourism where strongly affected. However, not all industries where equally affected. There is some evidence from the literature that the impact of COVID-19 has been extremely sector dependent and certain industries have been more affected by the COVID-19 pandemic than others. Manufacturing firms were the most adversely affected, while other like online communication or online shopping have seen unprecedented growth. Germany has the highest share of industry among the G7 countries, with vehicle manufacturing, electrical industry, chemical industry, and engineering being the strongest sectors, and is one of the three largest exporting nation. With a high manufacturing activity, Germany was hit significantly hard by the COVID-19 pandemic. The causes and the governmental response of the COVID-19 pandemic crisis differ considerably from other historical shocks to the economy. For example, natural disasters like an earthquake, influences firms within a short period of time and affects especially those companies surrounding the epicenter of the disaster event. In

contrast, the coronavirus pandemic differs especially from other local disasters due to its global impact and the fact that its effects may persist for years. The crisis management plans for business continuity fell short for a global pandemic as historically pandemics are low-probability events. Companies had to redirect their strategies to crisis management, social and environmental issues. The rapid adoption of technology and business model innovation was by far one of the most important measures in addressing the crisis. The focus was to offer new products and services through digital platforms in response to changes in the customer behavior. According to a *Harvard Business* study, firms with a good balance between reducing costs and investing during a period of recession have the highest probability of pulling out of the competition after the crisis.

This research tries to investigate the reactions of companies to the crisis by analyzing the stock market performance. Through the comparison of past performance and actual data, investors can have a better understanding of the impact of COVID-19 on the performance of listed companies. The event study methodology has been used to analyze the impact of the COVID-19 pandemic announcement in stock market and its effect on the short term. However, considering that the progress of the pandemic is uncertain and unpredictable, analyzing the behavior of returns through different periods of time seems a good approach to estimate financial performance on the long run.

Event-study method

The event-study methodology focuses on identifying those abnormal returns of firms for a specific interval of time. When analyzing stock indices, abnormal returns provide a means of assessing the capital market's response to specific events. With this method it can be determined whether the DAX stock market experienced significant abnormal returns in response to the COVID-19 pandemic. The first step of conducting an event study is to determine the event of interest and the period over which the stock prices of the firms are examined. The main event of this study is March 11, 2020, the day the pandemic announcement was made by the World Health Organization (WHO) and is defined by $[T_0]$. For the event window the period from January 27, 2020 to March 18, 2020 was selected and is determined by $[T_{-1} - T_1]$. The subsequent step is to define the estimation period, which has been defined to six months, from July 8, 2019 to January 3, 2020 and is determined by $[T_{-2} - T_{-1}]$. Finally, a post-event window is analyzed for the weeks following the event and is defined by $[T_1 - T_2]$.
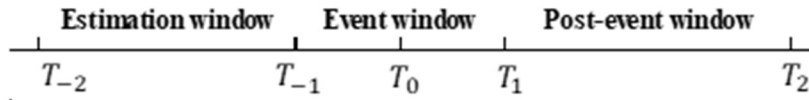
Timeline sequence for the event study

For this study, the mean-adjusted model has been adopted to obtain daily abnormal returns. For firm i at a time t the abnormal return is as follows:

$$AR_{it} = R_{it} - \bar{R}_i$$

Where the mean return $\bar{R}_1$ expresses the mean of stock firm's daily returns in the estimation period.

Since the announcement can remain for several days or weeks and the uncertainties persist, for this research the event window has been divided in two longer events, which are placed around the event occurrence and the following days. The first longer event period starts at the beginning of the window period (T_{-1}), and the second longer event period following the event day (T_0). For analyzing these longer event windows, the cumulative average abnormal returns (CARs) are necessary to accommodate a multiple period event window and are computed in a daily basis. Nevertheless, the results are displayed in weekly slots in order to see the evolution of the cumulative return during the event window and post-event window. The CARs for both longer windows under analysis are expressed respectively as follows:

$$CAR\ (T_{-1}, T_2) = \sum_{t=T_{-1}}^{T_2} AR_{i,t}$$

$$CAR\ (T_0, T_2) = \sum_{t=T_0}^{T_2} AR_{i,t}$$

Finally, the statistical significance of the abnormal returns is calculated with the t-test:

$$t = \frac{AR_t\ or\ AAR_t\ or\ CAR_t}{St.Dev.}$$

Based on the problem formulation, the following null hypothesis and alternative hypothesis are defined, respectively:

H_0 = *The pandemic announcement by WHO has no significant impact on the stock returns*

H_A = *The pandemic announcement by WHO has significant impact on the stock returns*

A test statistic smaller than the lower-tail critical value would provide statistical evidence that the COVID-19 announcement had a significant negative impact on the stock price on the event date.

The results show that from all DAX companies analyzed, 38 (out of 39) firms experienced negative abnormal returns with level of significance the day the WHO announced the global pandemic status. At sector level, all industries showed at the event day negative average abnormal returns (AARs) with level of significance. During the following week, except for internet & direct marketing retail, which was not statistically significant, the rest of industries showed also negative cumulative average abnormal returns (CAARs) with a certain level of significance. The industries that were more affected were aerospace, automobiles and components, construction materials, insurance, and industrial components, which needed between 4 and 6 weeks to recover levels before the announcement of pandemic.

Taking into consideration the cumulative returns since the beginning of the event window the results show that on the day the first tested positive was registered in Germany, the stock prices of aerospace, industrial conglomerates, textiles, semiconductors, software, logistics, and chemicals declined significantly. During the event window they continued to decline but slightly increased during the post-event window. Within 6 weeks the only industry that had bounced to pre-pandemic levels was health care equipment & services. After 12 weeks, telecommunication, financials, and real estate, also had bounced back to the levels before the pandemic. However, the industries aerospace, industrial conglomerates, textiles, pharmaceuticals, insurance, semiconductors, automobiles, and construction materials remained significantly affected for the whole analyzed period. At firm level, except Qiagen which was very mildly affected by the pandemic and just needed 8 days to rebound to pre-pandemic levels, and Sartorius and Symrise, which were only significantly affected during the event day and the week after, the rest of firms were severely affected by the pandemic.

Stability of DAX stock market

A further analysis has been performed to complement the findings from the previous study comparing the stock market performance of DAX firms between pre-pandemic and pandemic period, and determining which companies remained more stable and which were more affected in the long run. For comparison purposes, two main periods were defined: pandemic period, and pre-pandemic period. The pre-pandemic period selected is six months and reflects the behavior of the stock market in normal conditions and investment decisions were still not affected by the pandemic. As for the pandemic period, two different scenarios are considered. For the first one, January 27, 2020 (first infected with SARS-CoV-2 in Germany) is assumed as the beginning of the pandemic period. For a fair comparison, also a six-month period is considered as pandemic, and is defined by January 27, 2020 – July 27, 2020 (Period 1). For the second scenario, March 12, 2020, is assumed as the beginning of the pandemic, which relates to the first working day after the WHO stated officially that the COVID-19 has become a pandemic. The sub-periods of the second pandemic period considered are: 1 week, 2 weeks, 4 weeks, 6 weeks, 12 weeks, 24 weeks, 48 weeks, and 72 weeks after the announcement day.

The return stability measure (denoted by $\tilde{R}$) can reflect the difference between the pre-pandemic and pandemic periods by means of the following formula:

$$\tilde{R} = \frac{\overline{R}_1 - \overline{R}_0}{\overline{R}_0}$$

Where $\overline{R}_0$ and $\overline{R}_1$ represent the average returns of the DAX index over the pre-pandemic and pandemic periods, respectively. Meaning that $\tilde{R}$ reflects the relative change of the average returns.

The results show that the industry of internet & direct marketing, especially related to food delivery, and healthcare firms related to molecular diagnostics, applied testing and biotech, were affected very positively by the pandemic, as their returns were much higher than pre-pandemic period and the curve of growth seemed unaltered. The industries most adversely affected by the pandemic were aerospace, automobile & components, and construction materials, showing U-shape curves of recovery, meaning deep impact of pandemic and a slow recovery.

Comparing the relative change of the average returns of the DAX industries between pre-pandemic period and pandemic sub-periods of period 2, most companies showed a positive impact in the

mid-term, and needed between 4 to 24 weeks to recover. Internet and direct marketing retail were the exception, showing a positive impact in all the periods of the pandemic subject to this analysis. On the other side, the industries that had bigger declines in comparison to average returns before the pandemic, required more than one year to show a positive change. In the case of aerospace, construction materials, insurance, and household & personal products industries, they needed 72 weeks or still did not recover.

DAX performance in relation with COVID-19 cases

The relation between the performance of DAX index accumulated returns and the increase in cases from COVID-19 is analyzed empirically by means of a linear regression model. In the first place, the period analyzed is January 27, 2020 to January 12, 2022, which comprises the full data available at the time this is research was performed. As a second study, the period January 27, 2020 to June 4, 2020 is selected to analyze the impact of increase of COVID-19 cases in the performance of the stock market during the period comprised by the first wave of the pandemic. The regression of residuals revealed a high volatility in DAX stock market returns, with the highest volatility observed in the first quarter of 2020, when the pandemic started, and the subsequent period. It can be interpreted as a strong response at the beginning of the pandemic with a big uncertainty, suggesting that the increase of COVID-19 cases had less impact to the stock market returns after the second wave. The Ordinary Linear Squares (OLS) estimation of the linear regression model revealed that the relationship between these two variables is significantly high during the first wave, but no relationship is detected for the whole analyzed period. The correlation matrix also shows a negative correlation of cumulated returns and daily COVID-19 cases.

Based on this study, the following null hypothesis and alternative hypothesis are defined, respectively:

H_0: *The increase in cases from Covid-19 do not affect DAX performance*

H_A: *The increase in cases from Covid-19 affect DAX performance*

The null hypothesis states that the cumulated returns have no correlation with daily COVID-19 infections. The p-value reveals a strong evidence that the null hypothesis of no correlation can be rejected, hence cumulated returns and daily COVID-19 cases are correlated during the first wave.

Conclusions

It can be concluded from the study that the COVID-19 pandemic had a significant impact to the stock market performance of DAX companies, yet depending on the industry the effect can be either positive or negative. The pandemic has been especially harmful for some sectors as the lockdowns and travel bans were being implemented in order to prevent the spreading of the virus. Both the event study method and the analysis of stability and recovery showed that the industry of internet & direct marketing, and some healthcare sub-industries were the most beneficiated from the pandemic, showing better performance than pre-pandemic levels. In contrast, sectors such as aerospace, automobile and construction were deeply affected by the pandemic and are showing a very slow recovery. The rest of industries in average saw their performance negatively affected, especially during the first months of the pandemic, mainly due to disruption of supply chains and contraction of demand caused by lockdown and travel ban measures, but they manage to recover after a relative short period. In the last part of the research, it was determined that the increase of new daily COVID-19 cases was correlated to the performance of the stock market returns during the first wave of the pandemic but not for the full period. The regression of residuals showed a high volatility when the pandemic started as uncertainty was present, but as soon as people got used to the situation the impact of new daily cases had less impact to the stock market performance.

In relation to crisis management strategies, the companies that struggled the most during the pandemic, such as aerospace and automobile industries, also had to undergo extensive cost-saving measures, investments were reduced and credit facilities were extended to safeguard liquidity. Additionally, short-time working was introduced in most cases, and, in general, the priority for all the companies was to improve healthy measures and moving their business towards online channels and developing digitalization.