Louvain School of Management

The COVID-19 and Stock Markets returns

Evidence from the Europe, USA and Japan

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Academic year 2021-2022
Dissertation for the Master of Business Engineering
Financial Engineering
Daytime schedule

ACKNOWLEDGEMENTS

I wish to express my sincere recognition to all people who helped me throughout the writing process of my thesis. First, a special thanks to my supervisor, Pr. Leonardo Iania, for his multiple helpful advice and guidance in the realisation of this paper. I would also like to thank all professors and university staff for providing such a positive learning environment through my academic process. Finally, I would like to thank my friends and my parents for their support all along these years.

TABLE OF CONTENTS

INTRODUCTION

The earliest COVID-19 cases were reported in December 2019 in Wuhan, China. Despite the situation inside China having been gradually under control, the COVID-19 pandemic continued to spread globally. To deal with the skyrocketing cases of infection and death, numerous countries decided to impose partial or general lockdown by suspending business activities. Consequently, the global economy and stock markets had endured significant impacts due to the slowdown in demand and supply around the world at the same time. The Dow index which has always been the most prevalent American price-weighted index in the world recorded the largest single-day loss since the Black Monday Stock Market Crash in 1987. On 16th March 2020, the Dow Jones index plummeted by almost 3000 points, representing a loss of 12.9% in one day. The stock price loss was so critical that the New York Stock Exchange was forced to intervene by suspending trading activities several times in March 2020. However, the intervention efforts were not sufficient to cease the plunge in the Dow Index and it recorded a 37% loss of its value between 12th February 2020 and 23rd March 2020. The crisis did not only occur in the US but also escalated into a worldwide spectrum. The European stock market and Asian stock market also fell more than 10% on 12th March 2020, the day after the official announcement COVID-19 as global pandemic by the World Health Organization. It was no surprising that the pandemic was considered by the International Monetary Fund (IMF) the worst economic crisis that had caused unexpected severe global economic and financial disorders since the 1930s depression (BBC News, 2020).

Nowadays, there exists many asset-pricing models in Finance to describe the relationship between average stock returns and systemic risk. Among them one of the most popular and internationally tested framework is the Fama French 3 factors model, developed by Eugene Fama and Kenneth French. It is an extensive statistical model of the traditional Capital Asset Pricing Model (CAPM). On top of the market factor, the authors added the size factor and the value factor to describe stock returns. This study investigates the performance of the Fama French 3 factors model during turbulent COVID-19 period in the selected developed countries and economies. More specifically, we would like to test the performance of Fama French model in the European, American, and Japanese stock markets during the pandemic. Further analysis will be conducted as an application of the Fama French model on industry returns in America. The motivation of the research topic is to provide a more general view of how effective the Fama French model could explain the developed stock returns as well as industry returns during the stressed period of COVID-19 by studying several markets simultaneously.

The thesis is organised into three parts. First, the thesis introduces a comprehensive literature review that gathers information from previously published papers regarding the impacts of the COVID pandemic on the economy and the stock markets. Section 2 presents the methodology that will be used in this thesis as well as the description of the dataset collected for the empirical regressions. In this section, we will interpret and discuss the results of the framework. Finally, the conclusion section summarizes the findings regarding the performance of the Fama French 3 factors model in developed stock markets during the COVID-19 pandemic and the potential impacts of the pandemic on the American industries. This part also delineates a comparison of our results with the prior research stated in the literature review and a discussion on the limitations of this thesis.

SECTION 1: LITERATURE REVIEW

In this section, literature review of previously published research will be conducted and distributed into three main parts. The discussion starts presenting the developed stock markets that this study aims to investigate. The last two parts introduce an overview of scientific research regarding the impacts of the pandemic and financial crisis on the economy and on the stock markets.

1.1. The Developed Stock Markets and COVID-19

To better investigate the impacts of COVID-19 on a global scale, our study will consider the behaviours of 3 developed stock markets from 3 different continents. They are respectively the European Stock Market, American Stock Market, and Japanese Stock Market. In this section, we will briefly present the history of the listed Stock Market as well as their main stock market indexes under the global COVID-19 outbreak. Stock market indexes are powerful indicators to measure the global and specific country's economy. It collects data from a large range of enterprises across different sectors. Therefore, indexes offer a big landscape for investors to track market movements and performance.

1.1.1. European Stock Market

There are multiple stock exchanges in Europe since almost each European country has its own one. There are only five among them consisting of a market capitalisation exceeding USD 1 trillion. The largest stock exchange in Europe is EURONEXT, which was initially established in 2000 by the combination of the Amsterdam, Paris, and Brussels Stock exchange. After multiple mergers over the years, the group nowadays is the most notable pan-European bourse that operates exchanges independently in France, the Netherlands, Belgium, Portugal, Ireland, Norway, and Italy. EURONEXT offers a wide array of trading and post-trade services such as equities, exchange-traded funds, derivatives, clearing, settlement, etc. At the end of December 2021, the group listed nearby 2000 issuers that worth around €6.9 trillion in market capitalization, that is equivalent to 25% of equity trading activities in Europe (EURONEXT, 2022).

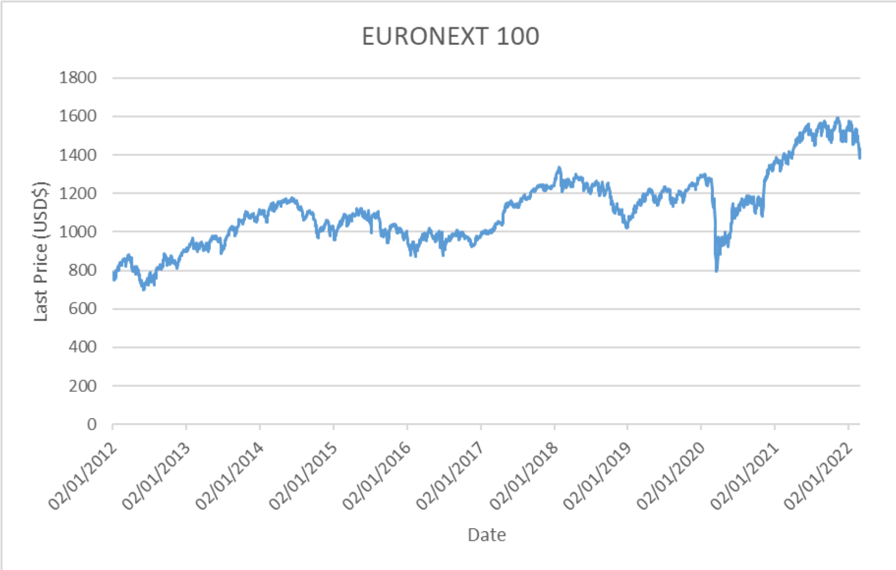

Figure 1. Fluctuation of last-day price for EURONEXT100 from Jan 2012 to Jan 2022. Source: Bloomberg Terminal.

Figure 1 shows the evolution of EURONEXT 100 index price from January 2012 to January 2022. Euronext 100 index was launched on October 2, 2000. It is a market capitalisation weighted index of the 100 largest and most liquid stocks traded on EURONEXT. Its composition is not fixed and will be reviewed quarterly. From the figure, the index lost more than 30% of its value after the official announcement of the COVID-19 as a global pandemic by the World Health Organization (WHO) in March 2020. The European stock market reached its bottom in the same month and stated to recover after the second quarter of 2020.

1.1.2. American Stock Market

On March 31st 2022, the total US Stock Market Capitalisation was reported at USD 48.26 trillion. There are two major financial securities markets in the United States. They are respectively the New York Stock Exchanges and Nasdaq.

The New York Stock Exchange (NYSE) is by far the largest stock exchange in the United States, also the world's largest stock exchange, with a market capitalization of USD 26.2 trillion as of March 2022, representing more than the half entire US Stock Market. The NYSE was founded on May 17th, 1792, followed by the Buttonwood Agreement in New York City as a response to t first American financial panic. The group operated for over 200 years as a non-profit organisation owned by its members. After the merger in March 2006 with Archipelago Holdings, it was listed under the symbol 'NYX'. The NYSE subsequently was expanded and merged with Euronext, the Europe's largest stock exchange to become the NYSE Euronext in 2007. In 2013, the latter was purchased by Intercontinental Exchange Corporation (ICE), the present parent organisation of the NYSE (The NYSE, 2022).

The NASDAQ, acronym of National Association of Securities Dealers Automated Quotation, was created in 1971 by the National Association of Securities Dealers. This largest global computer-based market has become more prevalent because of two main reasons. On one hand, its modern system reduces transaction costs efficiently and provide equal access to both individual and institutional traders worldwide. On the other hand, NASDAQ offered an easier entry for early-stage tech start-ups such as Google and Microsoft that did not meet the requirements of NYSE. The rapid development of those technology giants had soared the NSDAQ's valuation just behind the NYSE exchange. The exchange accounts currently more than 3500 listed enterprises with a total market value more than USD 9.1 trillion (NASDAQ, 2022).

There exist approximately five hundred Stock indices in the United States. However, the most popular indices by investors are S&P 500, Dow Jones Industrial Average, and NASDAQ Composite.

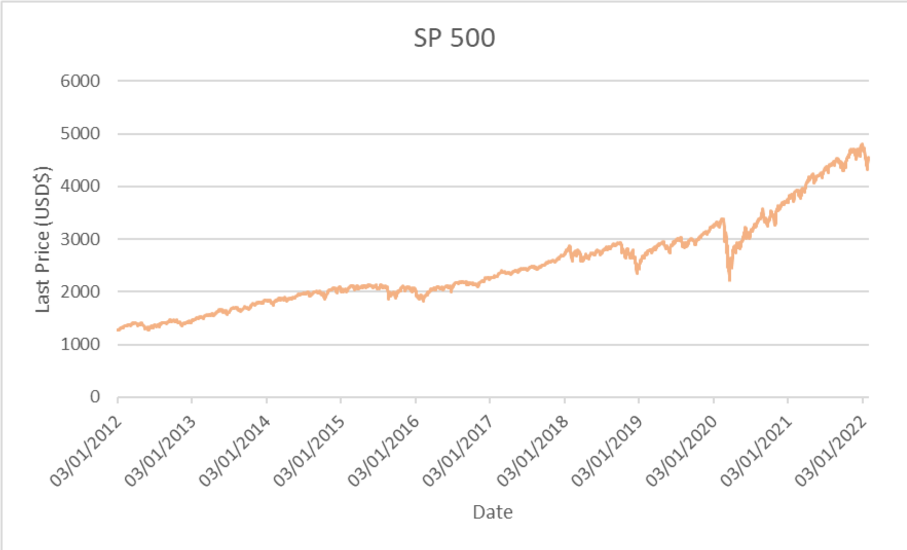

Figure 2. Fluctuations of last-day price for SP500 from Jan 2012 to Jan 2022. Source: Bloomberg Terminal.

Figure 2 presents the evolution of S&P500 stock index price from January 2012 to January 2022. The S&P 500, abbreviation of Standard & Poor's 500 index, illustrates around 80% of the total American stock market. The index, introduced in 1959, includes 500 of the top companies across all sectors which are carefully selected in the index following diverse criteria such market capitalisation, liquidity, financial viability, trading history, etc. Every stock contributes in proportion of their market capitalisation to the index. S&P 500 is thus a market-weighted index. The index had been showing an increasing trend until it reached the peak in February 2020 before it plummeted more than 30% when the pandemic hit.

1.1.3. Japanese Stock Market

The Tokyo Stock Exchange (TSE) is the main stock marketplace of Japan, founded in 1878 and headquartered in Tokyo. After the merger with the Osaka Securities Exchange (OSE) in 2013, the Japan Exchange Group is established. As of September 2021, the latter has more than 3700 listed companies included world-renowned giants notably Toyota, Sony, Honda, etc (JPX, 2022). There are 2 major stock indexes in Japan.

Figure 3. Fluctuations of last-day price for Nikkei from Jan 2012 to Jan 2022. Source: Bloomberg Terminal.

Figure 3 shows the fluctuations of Nikkei stock index price from January 2012 to January 2022. The Nikkei 225, also known as Nikkei Stock Average, is the main index of the Tokyo Stock exchange as well as of the entire country. The index was created in 1949 and was posed of the 225 most popular Japanese enterprises in various sectors. Such a composition will be reviewed and revised every year according to the performance of the enterprises (Nikkei Indexes, 2022). As shown in the figure, the index dropped more than 25% during the outset of pandemic within one month.

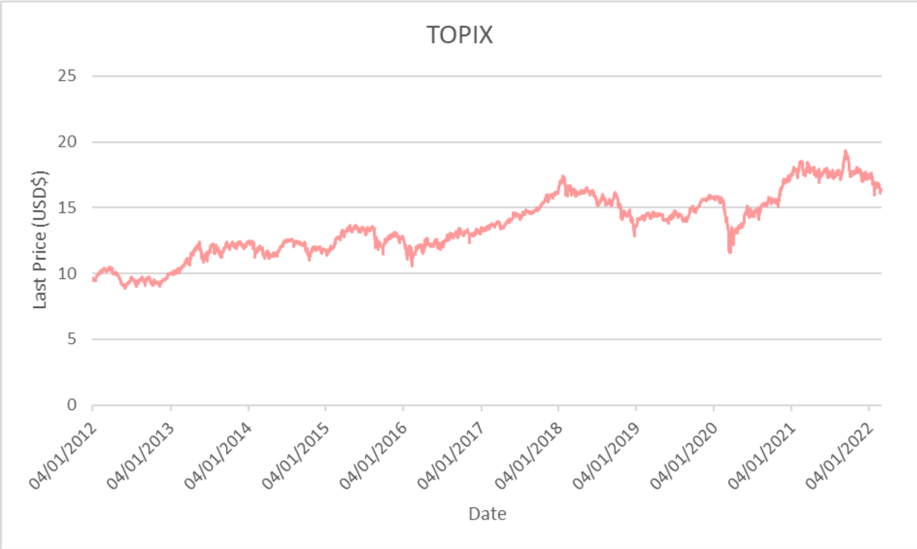

Figure 4. Fluctuation of last-day price for TOPIX from Jan 2012 to Jan 2022. Source: Bloomberg Terminal.

Figure 4 presents the evolution of TOPIX stock index price from January 2012 to January 2022. Another important index for TSE is the Tokyo Exchange Price index (TOPIX). It is a capitalization-weighted index of listed enterprises on the First Section of the TSE. It is deemed as a benchmark to invest in Japanese stock for two reasons. First, it covers an extensive array of public-owned stock in Japan. Secondly, it has a base value of 100 points as of the base date in January 1968 (JPX, 2022). The figure gives the same implication as the previous three, that is the index suffered significant losses in the early stage of COVID-19 outbreak. Both NIKKEI and TOPIX index prices started to recover to the pre-COVID level in the early Q3 2020.

1.2. COVID-19 outbreak and its impact on the economy

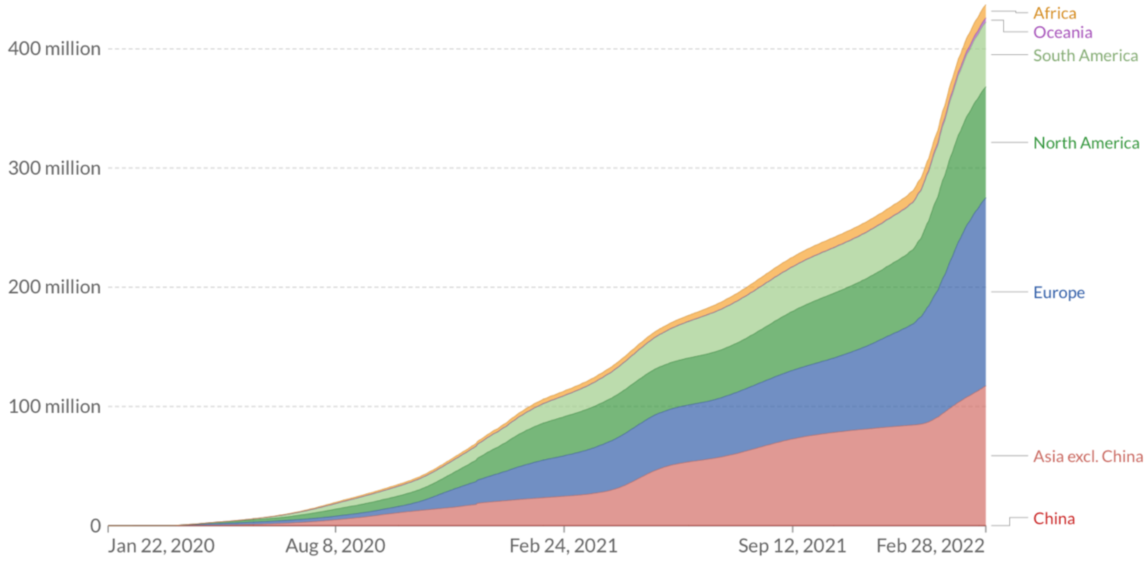

Figure 5. Cumulative confirmed COVID-19 cases by world region. Source: Our World in Data, 28/02/2022.

The SARS-CoV-2, abbreviation of Several Acute Respiratory Syndrome Coronavirus-2, is the causative pathogen for the respiratory illness of the ongoing COVID-19 disease. The latter is highly contagious virus and is mainly driven by human-to-human transmission when people breathe in the air. The infection caused by the virus has several substantial detrimental effects such as pneumonia, lung problems, respiratory failure, and death. The hardest hit area of the novel coronavirus had shifted from China to Europe and the United-States by January 2020. Figure 1 shows the cumulative new infected COVID cases by world region. The worldwide confirmed cases have been sharply increasing through the evolution of several variants such as delta and omicron in spite of the numerous implemented sanitary policies. There were 435 million cumulative cases recorded worldwide and the death benchmark was over 6 million cases until the end of February 2022 (Worldometers, 2022). However, the number of actual confirmed cases was believed to be underestimated. In fact, the reported figure is unavoidably much lower than the effective infected cases for several reasons such as different testing policies depending on the region, the number of tests performed and resources availability.

The worldwide expansion of COVID-19 has engendered significant economic slowdown due to suspension of business activities during lockdowns. The world Gross Domestic Product for 2020 was $84,705.57 Billion (compared to $87,607.92Billion in 2019) which represents a decline of 3.31% from the previous year (Megatrends, 2022). Following the virus outbreak throughout the world, there is an emerging appearance of research in analysing the impacts of the pandemic on the global economy. Eichenbaum, Rebelo and Trabandt (2020) pointed out that there is an inevitable trade-off between policy decisions and the severity of economic recessions. Indeed, policies that promote reducing the basic economic forces at work during the pandemic might save uncountable lives in the country. However, this kind of practice will unavoidably increase the severity of the recessions. In the same way, prioritising the economic growth will inevitably increase the number of deaths. In the previous health diseases, the stock markets showed a reverse relationship between the epidemic and stock returns in the hotel, tourism, wholesale, and retail sectors. In contrast, the food and beverage, biotechnology, and pharmaceutical sectors manifested positive connections with the stock returns during the outbreak (Chen et al., 2007; Chen et al., 2009; Ichev & Marinc, 2018). Scheonfeld (2020) observed many other drastically impacted sectors and industries during the Covid-19 pandemic. He extended the list by adding the gas and petroleum, garment, automobile and transport industries.

Regarding the macroeconomy tools, under the high uncertainty of the pandemic evolution, McKibbin and Fernado (2020) established seven scenarios in order to help policymakers by better predicting the possible outcomes of different policies. The scenarios analysis suggests that all economies should provide heavier investment in public health systems to avoid additional medical costs, especially in less developed countries. In fact, McKibbin and Fernado (2020) noticed that less developed countries are more likely to suffer severer repercussions because they have higher population density alongside with less developed healthcare systems. The paper Ma, Roger and Zhou (2020) also confirmed that increasing government spending in health care can significantly stimulate GDP growth recovery as well as the reduction of the unemployment rate after the pandemic. More generally, the authors observe that government fiscal policy are particularly useful to alleviate negative GDP growth. As consequences, developed countries are more likely to recover faster than from COVID-19 than emerging countries.

Moreover, Yan (2020), Ichev et al. (2018) and Harjoto et al (2021) figured out that small and medium-sized enterprises were suffering greater negative shocks than larger firms during diseases because SMEs have rather thin margins and insufficient capitals compared to large companies to deal with the unexpected economic downturns. Although many governments have provided massive fiscal aids to allow SMEs to keep their workers and pay payrolls, these actions remain as a cup of water to put out a cartload of firewood, especially for small firms. In fact, widespread production suspension, skyrocketing inventory costs due to depressed domestic consumption as well as fixed expenditure costs such as wages and rents are putting pressure on their weak capital structure (Duan et al., 2020). This could lead to massive bankruptcies and could further destabilise the banking system.

1.3. COVID-19 outbreak and its impact on the Stock Market

The financial sector, including banks and other financial institutions, was one of the most drastically influenced sectors by the pandemic. They have suffered a skyrocketing number of borrowers for non-performing loans to compensate for their income losses along with many short-term withdrawals by depositors (Goodell, 2020). In fact, the global shutdown alongside the worldwide economic downturn has triggered panic selling in the financial market which is regularly reflected in the major stock price drops.

Ichev and Marinc (2018) realized a study analysing the reaction of the stock prices of US firms during another severe pandemic, Ebola. They noticed that the transmission of the sanitary shock through the economy depends on the magnitude of the exposure inside the country. Later, Baker et al. (2020) consider the Coronavirus as the health pandemic that has the biggest impact on the global stock market in the 20th century because the sanitary restrictions (e.g. social distances, remote working, mobility restrictions, etc) appear as a devasting blow to our current service-based economy. In the first quarter of 2020, the medical shock due to rapid propagation of COVID-19 across European countries, especially in highly infected regions such as Italy and Spain, severely damaged financial market sentiment on the recovery of the global economy (Ben Amar, Hachicha & Halouani, 2020). A paper written by Fetzer et al (2021) documents a rapid emergence of economic anxiety due to COVID-19. The researchers conclude that the COVID news significantly increased the anxiety and vulnerability of investors which inevitably influenced their investment decisions. The abnormal trading activities caused by the COVID-19 outbreak undoubtedly destabilized the financial markets around the world (Zaremba et al., 2020). However, it is worth noting that the liquidity of derivatives seems to be positively impacted by the disease. This phenomenon can be explained by the surge of call options trading to hedge risks (Arany, 2020).

The study of Ben Amar et al. (2020) also suggests that the introduction of fiscal and monetary interventions in response to the outbreak appeared to have positive effect to equity market in the second sub-period of the pandemic. In agreement with the finding of Ma et al. (2020) that we mentioned in the previous section, the unprecedented pandemic has brought more severe repercussions on the stock markets of emerging countries because they have less advanced health-care systems and lower liquidity to establish fiscal and monetary policy (Harjoto, 2020).

It is well known that the stock markets tend to adjust their prices continuously in response to the news (Lyócsa, Molnár & Plíhal 2019; Caruso, 2019). At the outset of the Covid expansion, a study led by Ambros et al. (2020) did not find the impact of the number of COVID news on the stock returns, but their findings suggest that changes in Covid news generated rises in stock market volatility in February/March 2020, especially in European markets. In other words, changes in the number of Covid news can partially indicate the market uncertainty but it does not have significant impact on the stock returns. Baek and Lee (2020) and Ashraf (2020) provided evidence that the stock market volatility is positively affected by the spread of Covid-19 bad news (i.e. mortality rate, number of confirmed cases) and negatively affected by the good news (i.e. recovery rate). Numerous studies conducted in global scale confirm that the rise of volatility that is the increase in standard deviation, caused by the pandemic has serious repercussions on stock markets (Zhang et al., 2020; He et al., 2020). Furthermore, the researchers discover an asymmetric volatility influence by the pandemic, more specifically, the volatility of US stock market was more sensitive to the bad signs than the good news.

A study of Jawadi et al. finds that changes in infection and mortality rates due to the ongoing COVID-19 pandemic have Granger-caused the strong reaction of market trading, liquidity and volatility in both linear and non-linear ways. It is common knowledge that market disturbances might damage liquidity during hectic period characterized by the increase in risk and uncertainty (Lesmond, 2005; Liu, 2006). While examining the stock price reactions of the US market during the pandemic, Ramelli and Wagner (2020) noticed that investors and analysts begin to be more concerned about the firm's debt and liquidity which have endured important losses. The findings are consistent with the previous researchers, Baig et al. (2021)

who conducted a similar study during the time of the coronavirus pandemic. Their results suggest that the pessimism regarding future returns and the Covid related news such as mobility restrictions, social distance, infected cases, etc, severely erode market liquidity and stability. Specifically, their finding outcome shows that a rise of 1% in infected cases engenders a drop of 0.041% of liquidity. On top of that, their results suggest that the infected cases and volatility are positively correlated.

SECTION 2: EMPIRICAL ANALYSIS

2.1. Methodology

We are going to proceed the Fama French 3-factors model introduced in 1992 by the Nobel Laureate Eugene Fama and researcher Kenneth French. The authors proposed an extension model of the Capital Asset Pricing Model (CAPM) by adding the 2 additional risk factors, SMB and HML, to the existing excess return on the market. The CAPM aims to describe the link between systematic risk and expected return for stocks. Based on this model, Fama and French created the three-factors model which includes the size of firms and book-to-values to explain stock returns. The model can be presented as the following linear equation:

$$R_{it} - R_{ft} = \alpha_{it} + \beta_1\left(R_{Mt} - R_{ft}\right) + \beta_2 SMB_t + \beta_3 HML_t + \epsilon_{it}$$

Where:

R_{it} is the total return of portfolio i at time t

R_{ft} is the risk-free rate of return at time t

R_{Mt} is the total market portfolio return at time t

R_{it}-R_{ft} is the expected excess return

R_{Mt}-R_{ft} is the excess return on the market portfolio

SMB_t is the size premium

HML_t is the value premium

$\beta_{1,2,3}$ are factor loadings

RMt-Rft, also denotes market risk premium, which is the difference between the expected market return and the risk-free rate. It provides investors a supplementary return to compensate for the additional return volatility above and beyond the risk-free rate.

Small minus Big, SMB, is the difference between the returns on diversified portfolios of small and big capitalisation stocks. In other words, it measures the size effect of the market capitalisation of an enterprise. The SMB factor reveals that, in the long run, small capitalisation firms tend to perceive higher returns than big capitalisation companies.

High minus Low, HML, is the difference between the returns on diversified portfolios of high and low book-to-market stocks. This factor stipulates that, in the long run, value stocks (with a high book-to-market ratio) are likely to generate higher returns than growth stocks (with low book to market ratio).

We are going to run 3 regressions in total. The first equation is the classic 3-factors model presented above, which denotes model (1). The second model is the same model as (1) but includes the Dummy variable during the analysis period. The third equation uses the real figures of COVID-19 instead of processing the dummy to indicate the occurrence of confirmed cases during the COVID-19 period. The regression models are written as the following:

$$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \epsilon_{it} \quad (1)$$

$$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 Dummy_t + \epsilon_{it} \quad (2)$$

$$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_5 Growth_t + \epsilon_{it} \quad (3)$$

in which Dummy is the numerical variable representing the COVID period. It takes the value 1 if the COVID is present, and 0 otherwise. That is to say, the Dummy variable is equal to 1 during the period January 2020 to February 2022.

Growth is the monthly growth rate of either the new confirmed COVID cases or number of deaths related to the virus. The choice of covid variable is based on the Principal Component Analysis (CPA). We use the variable that has the highest CPA score for each region.

2.2. Data Selection

To respond to our first research question, we employ monthly 25 portfolios formed on Size and Book-to-market of European, American and Japanese Stock Markets from the open source of French library. These portfolios are constructed at the end of June each year and are the intersection of five portfolios selected on the basis of size (market equity, ME) and five portfolios constructed on the basis of the ratio of book equity to market equity (BE/ME). The breakpoints for size in year t is the quintile of the NYSE market equity at the end of June in year t. BE/ME in June of year t is the book equity for the previous financial year ending in year t-1 divided by the ME in December of year t-1. The breakpoints for BE/ME are the NYSE quintile of the market capitalisation at the end of June of year t (Kenneth R. French, 2022). It is worth mentioning that the 25 European portfolios are constructed with the following countries' returns: Austria, Belgium, Switzerland, Germany, Denmark, Spain, Finland, France, Great Britain, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, and Sweden. In the dataset, S1 stands for the smallest sized portfolio and S5 for the largest one. In the same way, the value effect is represented by the incremental increasing order of B, where B1 is the lowest BE/ME and B5 is the largest BE/ME.

Regarding the dataset used to tackle the second research question, we employ monthly 49 industry portfolios in America from the Kenneth Library. This study selected 16 industries that predominantly contribute to the American Gross Domestic Product, so that we could investigate more intuitively on the impact of the pandemic on the American economy. These industries are the Agriculture, Entertainment, Healthcare, Construction, Mining, Oil&Gas, Utilities, Communication, Personal Services, Business Services, Software, Transportation, Wholesale, Retail, Catering and Financial sectors. The selected sector definitions are presented in Appendix 1.

The 3 risk factors data for each analysed market are also collected from the Kenneth Library. They are computed based on 6 value-weighted portfolios established on Size and Book-to-Market value. The market factor is the value-weighted return of the aggregate CRSP American enterprises listed on the NYSE, AMEX or NASDAQ which obtain 10 or 11 for the

CRSP share code at the beginning of month t. The size factor, SMB, is the difference between the average return on the 3 smallest-size portfolios and the average return on the 3 biggest-size portfolios.

SMB = 1/3 (Small Value + Small Neutral + Small Growth)
– 1/3 (Big Value+ Big Neutral + Big Growth)

The value factor, HML, is the difference between the average return on the two value portfolios and the average return on the two growth portfolios.

HML = 1/2 (Small Value + Big Value) – 1/2 (Small Growth + Big Growth)

To investigate the impacts of the COVID-19 pandemic on developed markets, our database evidently contains daily new infected cases and deaths statistics of COVID-19 in the United States and Japan from Worldmeters (2022). We generate the COVID variables for Europe with the same countries listed previously for the European portfolio to ensure consistency. Then, we transform daily variables into monthly statistics. Finally, the monthly growth rates of new infected and death cases are computed.

The data before the Covid is also important in the analysis to better investigate the dynamics of stock markets during pre-COVID period in the past decade. A panel data of 8 years is thus taken into consideration to fill the gap before the pandemic that started about two years ago since January 2020. As a result, our dataset is composed of monthly data from January 2012 to December 2021 in which the sample period contains 120 months of observation in total.

2.3. Regression on 25 portfolios formed in Size and Book-to-market

2.3.1. Summary Statistics

Table 1
Summary statistics of the monthly Fama French 3 factors over the period January 2012 to December 2021

European stock market

	Statistics			Correlations		
	Mean	**Std**	**t**	**Rm-Rf**	**SMB**	**HML**
RM-RF	0.831	4.455	2.044**	1.000	-	-
SMB	0.254	1.711	1.626	0.081	1.000	-
HML	-0.230	2.705	-0.930	0.437	-0.069	1.000

American stock market

	Statistics			Correlations		
	Mean	**Std**	**t**	**Rm-Rf**	**SMB**	**HML**
RM-RF	1.317	3.944	3.658**	1.000	-	-
SMB	-0.005	2.456	-0.023	0.288	1.000	-
HML	-0.206	3.033	-0.746	0.146	0.154	1.000

Japanese stock market

	Statistics			Correlations		
	Mean	**Std**	**t**	**Rm-Rf**	**SMB**	**HML**
RM-RF	0.722	3.673	2.154**	1.000	-	-
SMB	0.203	2.231	0.999	0.030	1.000	-
HML	-0.293	2.878	-1.115	-0.072	-0.483	1.000

* The table above summarizes the returns of the 3 factors of Fama French of each region as well as their correlation matrix during the period January 2012 and December 2021.

In the European region, the average return of the market factor is 0.8312% per month or 9.9744% per year which is very large from an investment perspective. The average return of the size factor is 0.254% per month or 3.048% per year. Moreover, the average return of book-to-market factors is -0.2296% per month or -2.7552% per year. The average return of market and size factors are both positive, indicating that there could be a risk premium to compensate for the potential risk engendered by these 2 factors. The market factor is the only factor that is statistically significant in returns. The lack of statistical significance is probably due to the small sample period of only 120 months and the high volatility (standard deviation) over the observation period. The correlation matrix on the right side of the table shows that the market factors are positively correlated to HML factors with the coefficient of

0.4366. The other correlations are neglectable because of their very low values. We may consider that there is no multicollinearity issue between the explanatory variables.

Regarding the statistics in America, the average return of the market factor is 1.3171% per month, or 15.8052% per year which represents 50% higher than the returns in Europe. It is worth noting that the average return of the size factor is negative, -0.00525% per month (0.063% per year). It is also observed that the average return of book-to-market factors is -0.2064% per month, or -2.4768% per year. Just like the case of the European market, the small sample period and the high volatility during the COVID-19 pandemic might be the reasons why the market factor is the only factor that has statistically significant returns. Furthermore, the correlation matrix shows that all factors are positively correlated between them but with weak degrees. We believe there is no multicollinearity issue.

In the case of the Japanese factors, the average return of the market factor is 0.7224% per month, or 8.6688% per year which is deemed to be slightly significant from the investment perspective. However, compared to the above regions, the rate appears to be the lowest. The average return of the SMB factor is 0.2033% per month, or 2,4396% per year; whereas the average return for HML is -0.293% per month, or -3.516% per year. It is observed from the correlation matrix that the market factor is uncorrelated with the size and value factors (0.03 and -0.07 respectively). According to the coefficients, the value factor moves in the opposite way from the two others, the relationship with the market factor is neglectable and the one with the size factor has a negative coefficient of -0.483.

Table 2
Excess returns on 25 portfolios formed on size and Book-to-Market

European portfolios

	MEANS					STANDARD DEVIATIONS				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	0.923	1.119	1.146	1.056	1.081	5.094	4.965	4.802	4.730	4.840
2	1.288	1.380	1.115	1.008	1.038	5.021	4.877	5.154	5.053	5.465
3	1.296	1.334	0.934	0.968	0.997	5.028	4.890	5.153	5.049	5.673
4	1.306	1.213	0.889	0.948	0.821	4.484	4.638	4.825	5.151	5.918
Big	1.045	0.920	0.760	0.619	0.781	3.715	4.045	4.757	4.741	6.479

American portfolios

	MEANS					STANDARD DEVIATIONS				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	1.175	1.429	1.150	1.172	1.569	7.155	6.178	5.557	5.657	6.930
2	1.452	1.410	1.255	1.101	1.282	6.318	5.119	5.422	5.555	6.493
3	1.357	1.402	1.137	1.261	1.067	5.612	4.770	4.820	5.494	6.528
4	1.535	1.372	1.275	1.118	1.243	4.642	4.527	4.711	5.434	6.147
Big	1.654	1.287	1.121	0.953	1.420	4.052	3.629	3.926	4.364	6.485

Japanese portfolios

	MEANS					STANDARD DEVIATIONS				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Small	1.042	1.207	1.147	1.031	1.024	6.425	5.159	4.496	4.148	3.979
2	1.447	0.884	0.856	0.902	0.622	6.793	4.307	3.981	3.921	4.078
3	0.918	0.969	0.909	0.666	0.600	5.509	4.021	3.751	3.779	4.144
4	0.852	0.788	0.799	0.604	0.513	4.683	3.602	3.728	4.188	4.624
Big	0.922	0.737	0.857	0.524	0.689	4.088	3.790	3.568	4.155	5.078

In table2, the standard deviation of the size factor is large for every region; respectively 1.711%, 2.456% and 2.23% per month for Europe, US and Japan. With a more comprehensive review of Table 2, it is shown that the average returns are decreasing from the smallest to the biggest size portfolios in each BE/ME quintile, but except in the lowest quintile category. This result suggests that the smaller stocks yield higher excess returns than bigger stocks. These statistics are consistent with the finding of Fama and French that small-size stocks outperform big-size stocks in the long run. Regarding the standard deviation of portfolio returns, we can see that small size portfolio returns are indeed much more volatile than those of big size portfolios.

However, our results are against those of Fama and French postulating the outperformance of value stocks in comparison to growth stocks in the long run. In our results, except for the smallest size quintile, the growth portfolios generate higher returns than the value portfolios. This phenomenon could be a consequence of the stressed COVID period included in our sample period. Moreover, we find similar observation for the standard deviation of portfolio average returns. The return volatility of lowest BE/ME portfolios are higher than the highest BE/ME portfolios for smallest size portfolios in all 3 regions. However, the situation is reverse for bigger size quantiles, the higher value portfolio’s returns become more volatile than lower BE/ME quintiles.

2.3.2. Regression Results

Table 3

Intercepts of excess returns regressions on 25 portfolios formed on size and Book-to-Market

European portfolios

	α					t(α)				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
	$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \epsilon_{it}$ (1)									
Small	-0.311	-0.032	0.079	0.059	0.204	-2.520	-0.323	0.823	0.654	2.279
2	-0.002	0.196	-0.011	-0.001	0.077	-0.021	1.789	-0.122	-0.008	0.828
3	0.032	0.168	-0.187	-0.074	0.088	0.244	1.598	-1.671	-0.720	0.777
4	0.162	0.117	-0.129	-0.055	-0.091	1.484	0.971	-1.199	-0.470	-0.631
Big	0.199	0.064	-0.155	-0.128	0.060	2.579	0.781	-1.743	-1.369	0.520
	$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 Dummy_t + \epsilon_{it}$ (2)									
Small	-0.392	-0.074	-0.019	-0.016	0.118	-2.908	-0.688	-0.184	-0.162	1.222
2	-0.061	0.142	0.042	0.041	0.124	-0.524	1.183	0.421	0.422	1.217
3	0.071	0.302	-0.139	-0.087	0.118	0.498	2.719	-1.133	-0.771	0.956
4	0.224	0.160	-0.071	0.025	-0.077	1.884	1.207	-0.603	0.194	-0.486
Big	0.165	0.097	-0.145	-0.096	-0.022	1.947	1.087	-1.476	-0.933	-0.174
	$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_5 Growth_t + \epsilon_{it}$ (3)									
Small	-0.270	0.141	0.214	0.174	0.218	-1.124	0.845	1.531	1.508	2.314
2	0.088	-0.033	0.028	0.104	-0.149	0.310	-0.233	0.223	0.997	-1.696
3	-0.229	0.108	0.130	-0.074	-0.144	-1.157	0.825	0.999	-0.683	-1.445
4	-0.118	0.012	0.037	-0.169	-0.247	-0.631	0.102	0.331	-1.417	-1.780
Big	0.066	-0.056	0.208	-0.162	-0.008	0.649	-0.509	2.068	-1.475	-0.046

American portfolios

	α					t(α)				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
	$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \epsilon_{it}$ (1)									
Small	-0.330	0.091	-0.065	0.069	0.544	-1.271	0.408	-0.550	0.602	1.624
2	-0.131	0.111	-0.050	-0.048	-0.089	-0.715	0.933	-0.438	-0.418	-0.568
3	-0.255	0.068	-0.129	-0.038	-0.283	-1.591	0.597	-1.010	-0.310	-1.781
4	0.056	-0.021	-0.069	-0.240	-0.146	0.393	-0.170	-0.511	-1.356	-0.876
Big	0.173	0.030	-0.038	-0.179	-0.133	2.192	0.328	-0.291	-1.528	-0.632
	$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 Dummy_t + \epsilon_{it}$ (2)									
Small	-0.284	0.180	-0.057	0.161	0.226	-0.993	0.732	-0.435	1.285	0.625
2	0.070	0.232	0.004	0.031	-0.199	0.354	1.822	0.032	0.244	-1.164
3	-0.120	0.104	-0.001	-0.008	-0.315	-0.692	0.829	-0.007	-0.057	-1.803
4	0.128	0.007	-0.043	-0.230	-0.050	0.822	0.051	-0.292	-1.182	-0.276
Big	0.110	0.005	0.052	-0.056	-0.131	1.282	0.045	0.367	-0.445	-0.565
	$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_5 Growth_t + \epsilon_{it}$ (3)									
Small	-0.254	0.067	-0.082	0.078	0.545	-1.001	0.299	-0.695	0.668	1.611
2	-0.073	0.116	-0.069	-0.085	-0.011	-0.411	0.974	-0.599	-0.761	-0.076
3	-0.216	0.061	-0.161	-0.030	-0.276	-1.365	0.527	-1.280	-0.239	-1.719
4	0.073	-0.026	-0.064	-0.155	-0.103	0.514	-0.215	-0.469	-0.955	-0.626
Big	0.172	0.030	-0.047	-0.165	-0.122	2.149	0.321	-0.358	-1.402	-0.574

Japanese portfolios

	α					$t(\alpha)$				
	Low	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
	$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \epsilon_{it}$ (1)									
Small	-0.281	0.135	0.214	0.175	0.220	-1.169	0.805	1.533	1.520	2.349
2	0.080	-0.038	0.028	0.107	-0.144	0.282	-0.268	0.232	1.028	-1.637
3	-0.242	0.105	0.139	-0.074	-0.143	-1.212	0.809	1.059	-0.686	-1.442
4	-0.124	0.008	0.036	-0.173	-0.261	-0.664	0.071	0.319	-1.454	-1.834
Big	0.069	-0.048	0.205	-0.165	-0.012	0.680	-0.436	2.039	-1.508	-0.071
	$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 Dummy_t + \epsilon_{it}$ (2)									
Small	-0.216	0.189	0.230	0.092	0.203	-0.800	1.008	1.469	0.721	1.922
2	0.232	-0.077	-0.130	0.118	-0.155	0.737	-0.490	-0.968	1.005	-1.559
3	-0.342	0.098	0.139	-0.023	-0.126	-1.534	0.674	0.944	-0.191	-1.129
4	-0.146	0.099	0.141	-0.102	-0.242	-0.697	0.786	1.138	-0.766	-1.510
Big	0.037	-0.087	0.218	-0.142	-0.012	0.321	-0.699	1.929	-1.156	-0.066
	$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_5 Growth_t + \epsilon_{it}$ (3)									
Small	-0.270	0.141	0.214	0.174	0.218	-1.124	0.845	1.531	1.508	2.314
2	0.088	-0.033	0.028	0.104	-0.149	0.310	-0.233	0.223	0.997	-1.696
3	-0.229	0.108	0.130	-0.074	-0.144	-1.157	0.825	0.999	-0.683	-1.445
4	-0.118	0.012	0.037	-0.169	-0.247	-0.631	0.102	0.331	-1.417	-1.780
Big	0.066	-0.056	0.208	-0.162	-0.008	0.649	-0.509	2.068	-1.475	-0.046

Table 3 presents the intercept values of 3 regions. In the European Region, when the Fama 3 factors are the explanatory variables, the intercept values are close to 0. Only 2 intercepts among the 25 regressions differ from zero by more than 0.2% and 14 are within 0.1% per month. Then, after adding the dummy variable in the second regression and the growth rate of confirmed cases in the third regression, there is a tiny increase in the intercept values compared to the first regression. The number of intercepts exceeding 0.2% increases from 2 to 3 and 6 respectively. Moreover, the number of intercepts within 0.1% decreases from 14 in model 1 to 9 in model 3. We observe a general slight decrease in the intercepts in higher value quintiles and in the bigger size quintiles suggesting an improvement in the explanation of abnormal returns of higher value and bigger size portfolios. Regarding the American region, the 3 factors model's intercepts are overall higher than the 3 regressions in Europe. However, there are 13 intercepts in model 1 that differ from zero within 0.1% per month showing that the intercepts are still very close to zero. After the inclusion of a control variable, the intercepts in the lowest value quintile, higher value quintiles as well as bigger size quintiles are closer to zero. Lastly, the Japanese regression models have almost the highest intercept values in comparison with the 2 other regions. There are 6 intercepts among 25 of them that differ from 0 with more than 0.2% and only 9 intercepts that differ from 0 within 0.1% per month. An additional control variable decreases the magnitude of abnormal returns in the lowest value quintiles and in the higher value quintiles.

In summary, American portfolios have overall the highest intercepts than those of Europe, of which Japan has the lowest intercept values. This can be interpreted as the weaker ability for the 3 factors to capture return variations in the Japanese portfolios as opposed to the other two regions, although they are still considered to have a good explanatory power. The integration of either the dummy variable or the COVID variable changes the intercept values to a very slight degree in all regions. This indicates as a good sign for the model as the more intercepts are closer to zero, the better the model is explained. There is an improvement in the explanation of abnormal returns in the higher value portfolios in all three regions. Furthermore, the magnitude of alpha is smaller in the bigger size portfolios of Europe and America, simultaneously also smaller in the lower value portfolios of America and Japan.

Table 4

Regressions of excess returns regressions on 25 portfolios formed on size and Book-to-Market

$$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \epsilon_{it} \ (1)$$

Model 1 in Europe

	Low	2	3	4	High	Low	2	3	4	High
			β_1					$t(\beta_1)$		
Small	1.011	1.003	0.959	0.912	0.849	33.727	41.882	41.218	41.586	39.026
2	1.077	1.003	1.023	0.975	0.992	41.589	37.662	45.787	44.909	43.993
3	1.102	1.077	1.076	1.043	1.044	34.796	42.351	39.565	41.984	38.142
4	1.038	1.070	1.057	1.056	1.089	39.283	36.454	40.423	37.073	31.019
Big	0.909	0.971	1.069	0.961	1.092	48.549	48.977	49.496	42.369	38.938
			β_2					$t(\beta_2)$		
Small	1.200	1.020	0.919	0.910	0.894	17.051	18.156	16.825	17.665	17.514
2	1.004	1.019	0.986	0.830	0.802	16.514	16.291	18.789	16.282	15.139
3	0.792	0.654	0.709	0.597	0.479	10.660	10.944	11.104	10.248	7.452
4	0.441	0.270	0.310	0.457	0.351	7.099	3.916	5.043	6.830	4.262
Big	-0.311	-0.331	-0.132	-0.130	-0.074	-7.077	-7.114	-2.600	-2.445	-1.118
			β_3					$t(\beta_3)$		
Small	-0.189	-0.055	0.040	0.163	0.441	-3.824	-1.405	1.046	4.514	12.341
2	-0.415	-0.197	0.086	0.252	0.492	-9.746	-4.499	2.328	7.058	13.254
3	-0.445	-0.258	-0.007	0.097	0.547	-8.539	-6.169	-0.164	2.366	12.144
4	-0.539	-0.401	-0.070	0.155	0.556	-12.396	-8.295	-1.620	3.307	9.637
Big	-0.537	-0.385	-0.064	0.279	0.930	-17.439	-11.798	-1.796	7.473	20.157
			R^2					s(e)		
Small	0.935	0.956	0.956	0.960	0.962	1.301	1.038	1.009	0.952	0.943
2	0.950	0.944	0.965	0.965	0.968	1.123	1.156	0.970	0.942	0.978
3	0.926	0.949	0.948	0.955	0.956	1.374	1.104	1.180	1.077	1.187
4	0.935	0.925	0.945	0.943	0.934	1.147	1.273	1.134	1.235	1.523
Big	0.952	0.955	0.961	0.957	0.965	0.813	0.860	0.937	0.983	1.217

Model 1 in United-States

	Low	2	3	4	High	Low	2	3	4	High
			β_1					$t(\beta_1)$		
Small	1.069	0.979	0.937	0.901	0.856	16.382	17.413	31.608	31.103	10.179
2	1.117	0.967	1.014	0.940	1.128	24.245	32.541	35.038	32.384	28.579
3	1.136	0.999	0.982	1.043	1.129	28.229	34.678	30.649	33.619	28.268
4	1.040	1.043	1.037	1.089	1.156	29.090	34.448	30.627	24.504	27.550
Big	1.035	0.920	0.893	0.918	1.276	52.097	39.628	27.188	31.145	24.166
			β_2					$t(\beta_2)$		
Small	1.718	1.355	1.126	1.032	1.321	16.382	14.993	23.630	22.162	9.766
2	1.306	0.907	0.850	0.860	0.892	17.622	18.985	18.277	18.412	14.060
3	0.853	0.582	0.486	0.633	0.774	13.177	12.567	9.433	12.704	12.058
4	0.391	0.211	0.204	0.296	0.384	6.803	4.327	3.748	4.137	5.692
Big	-0.176	-0.229	-0.084	-0.088	0.214	-5.501	-6.122	-1.597	-1.854	2.517
			β_3					$t(\beta_3)$		
Small	-0.296	-0.048	0.283	0.597	0.685	-3.602	-0.683	7.575	16.364	6.459
2	-0.354	0.072	0.345	0.628	0.748	-6.088	1.926	9.453	17.155	15.044
3	-0.362	0.117	0.338	0.561	0.866	-7.129	3.225	8.386	14.342	17.205
4	-0.316	0.124	0.321	0.580	0.856	-7.010	3.242	7.519	10.364	16.178
Big	-0.346	0.013	0.301	0.594	0.834	-13.804	0.432	7.264	15.989	12.534
			R^2					s(e)		
Small	0.861	0.861	0.952	0.956	0.754	2.672	2.303	1.214	1.186	3.446
2	0.911	0.944	0.952	0.954	0.938	1.888	1.218	1.186	1.189	1.616
3	0.914	0.939	0.926	0.947	0.937	1.649	1.180	1.312	1.270	1.637
4	0.901	0.925	0.914	0.888	0.922	1.465	1.241	1.387	1.820	1.719
Big	0.960	0.932	0.883	0.924	0.889	0.814	0.951	1.345	1.208	2.163

Model 1 in Japan

	Low	2	3	4	High	Low	2	3	4	High
			β_1					$t(\beta_1)$		
Small	1.290	1.061	0.952	0.911	0.920	20.072	23.687	25.544	29.599	36.636
2	1.246	0.948	0.927	0.938	0.982	16.518	25.335	28.210	33.628	41.602
3	1.101	0.937	0.896	0.930	1.027	20.652	26.923	25.552	32.435	38.650
4	0.919	0.883	0.954	1.077	1.149	18.426	29.070	31.855	33.758	30.136
Big	0.969	0.953	0.927	1.064	1.211	35.449	32.029	34.455	36.286	27.008
			β_2					$t(\beta_2)$		
Small	1.271	1.211	1.102	1.041	0.968	10.544	14.410	15.758	18.028	20.563
2	1.122	0.820	0.789	0.802	0.856	7.929	11.680	12.799	15.322	19.319
3	0.900	0.624	0.582	0.624	0.635	9.001	9.564	8.842	11.588	12.740
4	0.427	0.282	0.269	0.290	0.360	4.561	4.951	4.795	4.846	5.039
Big	-0.319	-0.128	-0.125	-0.267	-0.099	-6.225	-2.300	-2.476	-4.855	-1.178
			β_3					$t(\beta_3)$		
Small	-0.296	-0.048	0.082	0.200	0.351	-3.158	-0.743	1.506	4.466	9.586
2	-0.662	-0.082	0.165	0.311	0.554	-6.022	-1.510	3.435	7.650	16.115
3	-0.464	-0.052	0.140	0.357	0.589	-5.971	-1.020	2.746	8.546	15.207
4	-0.616	-0.135	0.088	0.358	0.597	-8.475	-3.051	2.027	7.696	10.739
Big	-0.588	-0.265	0.129	0.240	0.680	-14.765	-6.111	3.285	5.619	10.402
			R^2					s(e)		
Small	0.841	0.880	0.891	0.912	0.937	2.569	1.791	1.489	1.230	1.003
2	0.803	0.880	0.892	0.920	0.947	3.015	1.496	1.314	1.115	0.944
3	0.851	0.881	0.861	0.908	0.935	2.131	1.390	1.402	1.147	1.062
4	0.819	0.887	0.897	0.908	0.892	1.992	1.214	1.198	1.275	1.524
Big	0.929	0.902	0.910	0.921	0.876	1.092	1.189	1.075	1.172	1.792

In the European region, the R^2 of all portfolios varies between 0.92 and 0.97, meaning that the Fama French 3 risk factors are very significant to explain stock returns. The R^2 of American portfolios are overall slightly lower than the European portfolios; the values vary between 0.75 and 0.96. In line with our intercept interpretations, we observe that the explanatory capability of the 3 risk factors is the weakest in Japan with values ranging between 0.80 and 0.95. However, the R^2 values are generally approaching 0.9 in the 3 regions which suggests that the 3 factors have demonstrated a remarkable explanatory power for the analysed stock markets.

The Market factor – We can observe that t-statistic of market excess return factor in 3 regions are all strongly significant. In particular, the t-values are greater than 31 in Europe, greater than 10 in US, and 16 in Japan proving that the risk premium clearly captures changes in stock variation returns. The β coefficients all are positive and move around 1 meaning that the stock price movement follow the movement of the market.

The Size factor – The slopes of the SML factor are mostly positive and move around 1 for all smallest size quintiles in all the three regions. The value of the slopes decreases gradually from smaller to bigger-size quantiles in which most of the value diminishes to negative. This result occurs for most of the slopes but solely with one exception: the t-statistics of small stock's SMB slopes in Europe are all significant with values between -2.44 and 18.15. The American and Japanese regression coefficients follow approximately the same trends as the European ones. The regression loadings of the Fama French 3 factors model measure the risk of a stock relative to the risk factor. We notice that the loadings of American and Japanese SMB are overall higher than those in Europe; of which the American portfolios dominate in the size factor category. It means that American portfolios have a stronger relationship with the size premia. In other words, investors in America expect higher additional returns for the size risk factor than other regions.

The HML factor - The slopes of HML are generally much weaker than those of the market and SMB factors. The β coefficients change from strongly negative values for low book-to-market quintile to strongly positive values for high book-to-market quintile. Their corresponding t-statistic is mostly significant and changes in the same way. Therefore, the HML clearly captures variation in stock returns. In a comparison of the three regions, we remark that the loadings of HML factor are the highest for the American portfolios, followed by the European ones, whereas the Japanese portfolios have the lowest βs for the value factor. Same interpretation as for size factor, the higher value size factor loadings in the United States suggest that American investors require higher expected returns to compensate for the risk rendered by the difference of value between portfolios.

Table 5
Regressions of excess returns regressions on 25 portfolios formed on size and Book-to-Market

Model 2

$$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 Dummy_t + \epsilon_{it} \quad (2)$$

Model 3

$$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_5 Growth_t + \epsilon_{it} \quad (3)$$

Europe

	LOW	2	3	4	HIGH	LOW	2	3	4	HIGH
			β_1					β_1		
Small	1.007	1.001	0.954	0.909	0.845	1.015	1.002	0.956	0.906	0.843
2	1.074	1.001	1.026	0.977	0.994	1.087	1.001	1.022	0.980	0.984
3	1.104	1.084	1.078	1.042	1.045	1.073	1.070	1.063	1.062	1.042
4	1.041	1.072	1.060	1.059	1.089	1.035	1.064	1.057	1.044	1.081
Big	0.908	0.972	1.069	0.962	1.089	0.909	0.974	1.059	0.962	1.094
			β_2					β_2		
Small	1.194	1.017	0.912	0.904	0.888	1.208	1.020	0.913	0.897	0.884
2	1.000	1.015	0.990	0.833	0.805	1.024	1.015	0.983	0.839	0.786
3	0.795	0.664	0.713	0.596	0.481	0.736	0.638	0.683	0.635	0.475
4	0.445	0.273	0.314	0.462	0.352	0.433	0.259	0.309	0.433	0.336
Big	-0.314	-0.328	-0.131	-0.128	-0.080	-0.312	-0.324	-0.152	-0.127	-0.071
			β_3					β_3		
Small	-0.180	-0.051	0.051	0.171	0.451	-0.185	-0.055	0.038	0.158	0.437
2	-0.409	-0.191	0.080	0.248	0.487	-0.407	-0.199	0.084	0.256	0.485
3	-0.449	-0.273	-0.013	0.098	0.543	-0.468	-0.264	-0.018	0.112	0.545
4	-0.546	-0.405	-0.076	0.146	0.555	-0.542	-0.405	-0.070	0.145	0.550
Big	-0.534	-0.388	-0.065	0.275	0.939	-0.538	-0.382	-0.072	0.280	0.931
			R^2					R^2		
Small	0.936	0.956	0.958	0.961	0.963	0.935	0.956	0.956	0.960	0.962
2	0.950	0.944	0.965	0.965	0.968	0.951	0.944	0.965	0.965	0.968
3	0.925	0.952	0.948	0.954	0.956	0.931	0.949	0.949	0.957	0.956
4	0.935	0.925	0.945	0.943	0.933	0.934	0.925	0.944	0.943	0.934
Big	0.952	0.955	0.961	0.957	0.965	0.952	0.955	0.962	0.957	0.965

United-States

	LOW	2	3	4	HIGH		LOW	2	3	4	HIGH
			β_1						β_1		
Small	1.070	0.982	0.937	0.904	0.844		0.997	1.001	0.953	0.893	0.855
2	1.125	0.972	1.016	0.943	1.123		1.063	0.962	1.031	0.975	1.055
3	1.141	1.000	0.986	1.044	1.128		1.100	1.006	1.011	1.035	1.123
4	1.043	1.044	1.038	1.089	1.160		1.024	1.049	1.033	1.009	1.115
Big	1.033	0.919	0.896	0.923	1.276		1.037	0.921	0.901	0.905	1.266
			β_2						β_2		
Small	1.721	1.361	1.127	1.037	1.301		1.692	1.363	1.132	1.029	1.320
2	1.318	0.915	0.854	0.864	0.885		1.286	0.905	0.857	0.872	0.865
3	0.861	0.584	0.494	0.635	0.772		0.839	0.585	0.497	0.630	0.772
4	0.396	0.212	0.206	0.296	0.390		0.385	0.213	0.202	0.267	0.369
Big	-0.180	-0.230	-0.079	-0.080	0.214		-0.175	-0.228	-0.081	-0.093	0.210
			β_3						β_3		
Small	-0.299	-0.053	0.283	0.592	0.702		-0.384	-0.021	0.303	0.588	0.683
2	-0.364	0.066	0.342	0.624	0.754		-0.420	0.065	0.366	0.670	0.658
3	-0.369	0.115	0.332	0.559	0.868		-0.407	0.126	0.375	0.551	0.858
4	-0.320	0.122	0.320	0.580	0.850		-0.336	0.130	0.315	0.483	0.806
Big	-0.342	0.014	0.296	0.587	0.834		-0.344	0.013	0.311	0.578	0.822
			R^2						R^2		
Small	0.860	0.861	0.952	0.957	0.761		0.869	0.861	0.953	0.956	0.752
2	0.915	0.946	0.952	0.955	0.939		0.917	0.943	0.953	0.958	0.950
3	0.916	0.939	0.929	0.946	0.937		0.917	0.939	0.929	0.947	0.937
4	0.901	0.925	0.913	0.887	0.923		0.901	0.925	0.913	0.907	0.926
Big	0.961	0.931	0.885	0.927	0.888		0.959	0.931	0.883	0.924	0.888

Japan

	LOW	2	3	4	HIGH		LOW	2	3	4	HIGH
			β_1						β_1		
Small	1.290	1.061	0.952	0.912	0.920		1.279	1.055	0.951	0.911	0.922
2	1.245	0.949	0.929	0.938	0.982		1.238	0.943	0.928	0.941	0.987
3	1.102	0.937	0.896	0.930	1.026		1.088	0.934	0.905	0.931	1.028
4	0.919	0.882	0.953	1.076	1.149		0.913	0.880	0.953	1.073	1.134
Big	0.969	0.954	0.927	1.064	1.211		0.971	0.961	0.924	1.061	1.207
			β_2						β_2		
Small	1.260	1.202	1.099	1.054	0.971		1.242	1.194	1.100	1.042	0.976
2	1.096	0.827	0.816	0.800	0.857		1.101	0.807	0.792	0.809	0.868
3	0.917	0.625	0.582	0.615	0.632		0.867	0.618	0.606	0.624	0.637
4	0.430	0.267	0.252	0.278	0.357		0.411	0.273	0.265	0.279	0.322
Big	-0.314	-0.122	-0.127	-0.271	-0.099		-0.311	-0.109	-0.134	-0.276	-0.110
			β_3						β_3		
Small	-0.302	-0.054	0.080	0.208	0.352		-0.306	-0.054	0.081	0.201	0.353
2	-0.677	-0.079	0.179	0.310	0.555		-0.669	-0.087	0.165	0.314	0.559
3	-0.454	-0.051	0.140	0.353	0.587		-0.475	-0.054	0.149	0.357	0.589
4	-0.614	-0.144	0.079	0.351	0.595		-0.621	-0.138	0.087	0.354	0.583
Big	-0.585	-0.261	0.128	0.238	0.680		-0.585	-0.258	0.126	0.237	0.676
			R^2						R^2		
Small	0.840	0.879	0.890	0.913	0.936		0.841	0.880	0.890	0.912	0.937
2	0.804	0.879	0.897	0.919	0.946		0.803	0.880	0.891	0.919	0.947
3	0.851	0.880	0.860	0.908	0.934		0.853	0.880	0.864	0.908	0.934
4	0.818	0.889	0.900	0.908	0.891		0.819	0.887	0.897	0.908	0.898
Big	0.928	0.901	0.909	0.920	0.875		0.929	0.904	0.909	0.920	0.875

Table 5 presents the regression coefficients of model 2 and model 3 in three regions. As to focus on interpreting the change in Fama French 3 risk factors during the pandemic, the estimated coefficients of control variables, i.e. coefficients of dummy COVID variable and growth rate of new confirmed cases variables, are not listed in the table. The sign and the significance of t-scores for market, size and value factors are identical to the ones in model 1. For clearer presentation purposes, t-scores and estimated coefficients of control variables are attached in Appendix 2 and 3.

After incorporating the COVID dummy variable or the growth rate of new confirmed cases variable in the basic 3 factors models, the R^2 of each region's model are very similar to those of model 1 with a very slight variation. The high value of R^2 in every portfolio quintile suggests robust explanatory power of model 2 and model 3.

The SMB factor – Under the influence of control variables, we notice that the SMB coefficients in Europe and in Japan have increased in bigger size portfolios and have decreased in smaller size quintiles. It means that, in Europe and Japan, investors require higher size premia for bigger size stocks than smaller size stocks during the COVID-19 pandemic. In American portfolios, SMB loadings increase in each size quintile when a COVID variable is added. This would signify that investors require higher risk premia for any size stocks in America.

The HML factor – After adding a COVID control variable, we remark a slight increase in the HML loadings in European and in American portfolios in lower value quintiles as well as a slight decrease in the higher value quintiles. We can say that investors expected higher value premia for European and American portfolios which contain high BE/ME stocks to cover the additional risk during the pandemic than those containing low BE/ME stocks. Regarding the situation in Japan, the HML loadings have overall increased in each value quintile representing the demand on higher risk premium for all types of BE/ME stocks.

2.4. Regression on 16 industry portfolios in United-States

2.4.1. Description of the industry portfolios

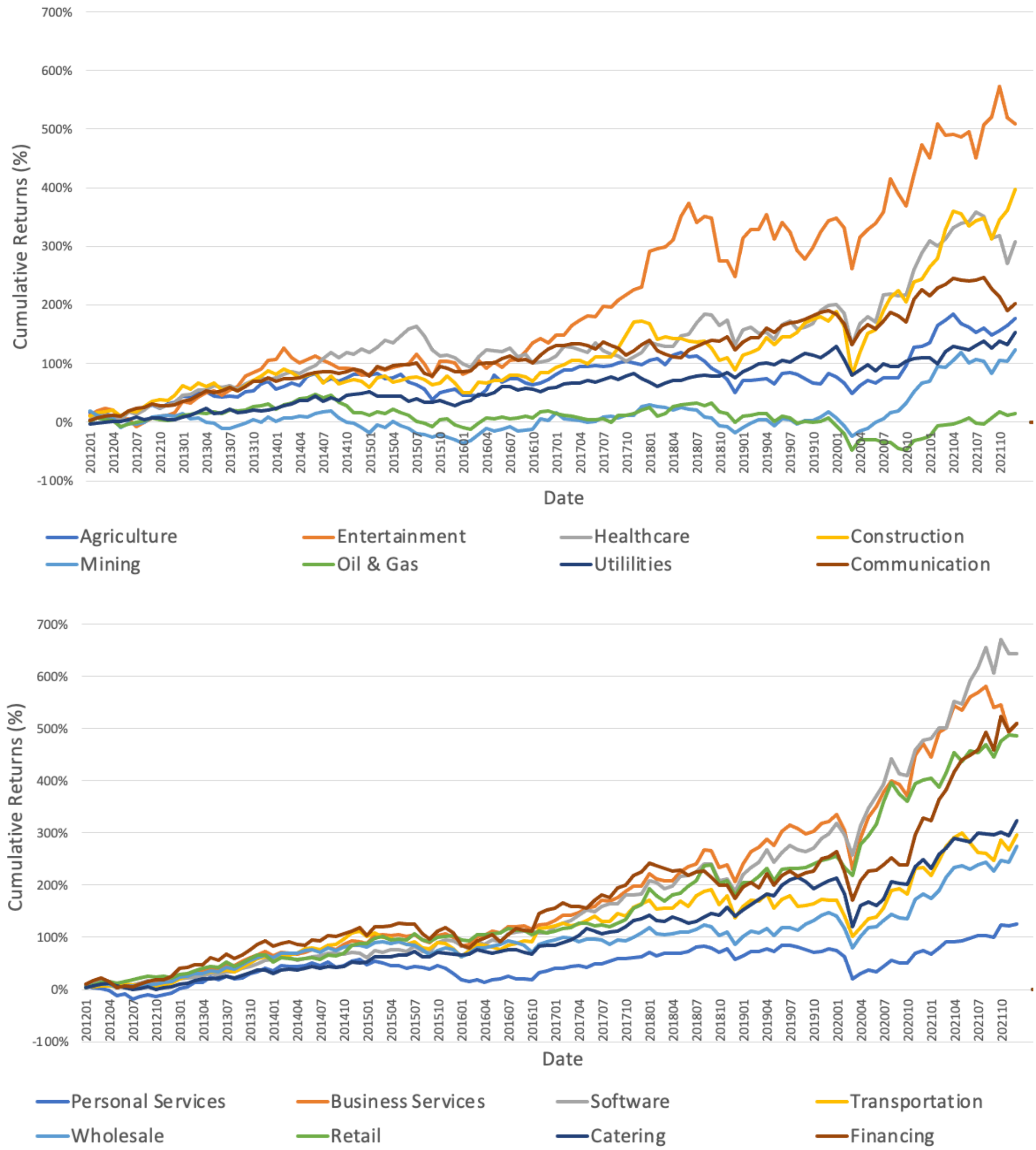

Figure 6: Cumulative returns of 20 sectors between 2012-2021. Source: Kenneth Library.

Figure 6 shows the cumulative returns of 16 sectors between January 2012 and December 2021. Cumulative return measures the total amount of an investment gain or loss over a set time. The 16 sectors are represented in 2 graphs for clearer demonstration purposes. We can see that the software industry yields the highest cumulative returns of 643%. In comparison, the sector that yields the lowest cumulative return is the Oil & Gaz sector with only 15% during the analysis period. Overall, we can observe a sharp decrease in cumulative returns in every industry in early 2020. Each sector started to recover rapidly after Q2 2020 except the Oil & Gaz and Utilities sectors which began to recuperate only in the late last quarter of 2020. While observing the magnitude of losses, the hardest-hit sectors by the COVID pandemic in America are the Construction, Personal and Services industries. Their cumulative returns plunged more than 50% between the end of 2019 and the second quarter of 2020. However, our findings also show that the cumulative returns of 6 sectors have surged more than twofold from the end of 2019 and the end of 2021. These sectors are the Agriculture, Construction, Mining, Oil&Gas, Software and Financial industries.

2.4.2. Regression Results

The regression loadings of Fama French 3 factors as well as their p-value significance are presented in Table 6. The Utilities, Agriculture and Mining sectors are the 3 sectors among 16 that have the regression R^2 lower than 0.5 with 0.229, 0.371 and 0.432 respectively. The Business services industry has the highest R^2, 0.859. The remaining sectors have values ranging from 0.55 to 0.84. However, the Oil&Gas is the only sector that has a statically significant alpha meaning that there are abnormal returns which are not explained by the 3 independent factors over the analysed period. In a nutshell, the results show that the Fama French 3 risk factors have a rather exceptional explanatory power in industry returns.

Table 6
Regressions of excess returns regressions on 16 industry portfolios

$$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \epsilon_{it} \ (1)$$

	Alpha		Market		SMB		HML		R^2
Agriculture	-0.045		0.787	**	0.275		0.150		0.371
Entertainment	0.058		1.199	**	0.349	**	-0.254	*	0.556
Healthcare	-0.010		0.995	**	0.339	**	0.022		0.546
Construction	-0.076		1.260	**	0.309	**	0.268	**	0.657
Mining	-0.484		1.154	**	0.207		0.536	**	0.432
Oil & gas	-1.086	**	1.277	**	0.559	**	0.969	**	0.700
Utilities	0.210		0.471	**	-0.295	**	0.144		0.229
Communication	-0.101		0.823	**	-0.162		0.099		0.611
Personal services	-0.478		1.001	**	0.195		0.312	**	0.672
Business services	0.095		1.109	**	0.184	**	-0.157	**	0.859
Software	0.263		1.064	**	-0.139	*	-0.363	**	0.819
Transportation	-0.109		1.075	**	0.046		0.275	**	0.695
Wholesale	-0.113		1.011	**	0.156	**	0.246	**	0.842
Retail	0.181		0.973	**	-0.148	*	-0.319	**	0.744
Catering	0.111		0.898	**	-0.176		0.143	*	0.615
Finance	0.193		1.151	**	0.167	*	0.400	**	0.807

The Market factor loading of each industry is positive and statistically significant at 5% level. Regarding the size factor coefficients, there are 7 out of 16 coefficient values significant at 5% level and 3 significant at 10%. The most significant size loading is positive which suggests that the industry benefits from exposure to size premium. These industries are Entertainment, Healthcare, Construction, Oil&Gaz, Business Services, Wholesale and Finance sectors. However, there are also some industries that have statistically significant negative SMB coefficients which suggest a negative effect of the exposure to size premium on the investor returns in that sector. These sectors are Utilities, Software and Retail industries. Furthermore, for the value risk factor, there is an aggregate of 12 significant HML loadings out of 16; which are composed of 10 and 2 statistically significant industries at 5% and 10% level respectively. Among the 12 significant loadings, only 4 industries have negative relationship with the exposure to value premium. They are the Entertainment, Business Services, Software and

Retail sectors. The p-values of HML betas are insignificant in the Agriculture, Healthcare, Utilities and Communication sectors.

Then, we ran the regression model of the Fama French 3 factors model with one additional control variable, the binary dummy variable that takes the value 1 during the COVID period. Table 7 lists the regression coefficients and the corresponding p-values. After incorporation of the Dummy variable, there is still only one statistically significant alpha out of 16. Compared to the previous model, the R^2 of Utilities, Agriculture and Mining industries remain below 0.5 indicating that these industry returns would be better explained by other factors than the Fama Franch 3 Risk Factors.

Table 7
Regressions of excess returns regressions on 16 industry portfolios

$$R_{it} - R_{ft} = \alpha_{it} + \beta_1\left(R_{Mt} - R_{ft}\right) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 Dummy_t + \epsilon_{it} \quad (2)$$

	Alpha	Market	SMB	HML	Dummy	R^2
Agriculture	-0.139	0.783**	0.270	0.155	0.495	0.367
Entertainment	0.316	1.208**	0.366**	-0.268**	-1.371	0.559
Healthcare	0.096	0.999**	0.346**	0.017	-0.562	0.544
Construction	-0.252	1.254**	0.298*	0.278**	0.931	0.657
Mining	-0.854	1.140**	0.183	0.556**	1.964	0.438
Oil & gas	-1.134**	1.275**	0.556**	0.972**	0.252	0.697
Utilities	0.258	0.472**	-0.292**	0.142	-0.255	0.223
Communication	0.153	0.832**	-0.147	0.085	-1.350**	0.625
Personal services	-0.451	1.002**	0.196	0.310**	-0.143	0.670
Business services	0.237	1.114**	0.193**	-0.164**	-0.750*	0.862
Software	0.186	1.061**	-0.143*	-0.359**	0.406	0.818
Transportation	-0.112	1.075**	0.046	0.275**	0.016	0.693
Wholesale	-0.156	1.010**	0.153**	0.248**	0.226	0.841
Retail	0.158	0.972**	-0.149*	-0.318**	0.121	0.742
Catering	0.135	0.899**	-0.174	0.141	-0.126	0.611
Finance	0.127	1.148**	0.163*	0.403**	0.351	0.806

After including the dummy control variable in the regression, the significance and the sign of size factor loadings remain the same as in the previous model. Regarding the value factor, we remark that the significance of the Entertainment industry changed from 10% to 5%. On the other hand, the HML coefficient of Catering sector, which was initially statistically significant at 10%, turned to be insignificant after the inclusion of the dummy variable. We can observe that the dummy variable is statistically significant in the Communication and Business Services industries, the betas are -1.35 and -0.75 respectively, indicating that both sectors recorded statistically significant negative returns during the pandemic.

The last regression model seeks to describe the relationship between the industry returns and the 3 risk factors plus the growth rate of confirmed cases. The factor loadings and p-values significance are presented in Table 8. The same outcome as in the previous 2 models, the Oil&Gas sector is the only one industry that has a statistically significant negative alpha with a value of -0.96. Compared to the two previous models, the alpha in model 3 is the lowest which signs that a part of the abnormal returns of this sector is explained by the new added growth rate factor. We remark that there is an overall increase of the R2 in every sector after the growth rate variable is added. This newly added instrument variable has successfully improved the overall regression fit.

Table 8

Regressions of excess returns regressions on 16 industry portfolios

$$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_5 Growth_t + \epsilon_{it} \quad (3)$$

	Alpha		Market		SMB		HML		Growth		R^2
Agriculture	-0.098		0.836	**	0.293	*	0.210		0.756		0.373
Entertainment	0.095		1.163	**	0.337	*	-0.298	**	-0.540		0.555
Healthcare	-0.035		1.018	**	0.348	**	0.050		0.344		0.544
Construction	0.007		1.183	**	0.281	*	0.173		-1.186	**	0.666
Mining	-0.546		1.212	**	0.227		0.607	**	0.885		0.433
Oil & gas	-0.960	**	1.159	**	0.517	**	0.824	**	-1.806	**	0.717
Utilities	0.253		0.430	**	-0.310	**	0.095		-0.613		0.233
Communication	-0.094		0.816	**	-0.165		0.091		-0.099		0.608
Personal services	-0.424		0.950	**	0.176		0.250	**	-0.767	*	0.678
Business services	0.148		1.059	**	0.166	**	-0.218	**	-0.761	**	0.868
Software	0.281		1.048	**	-0.145	*	-0.384	**	-0.258		0.818
Transportation	-0.125		1.090	**	0.052		0.293	**	0.225		0.693
Wholesale	-0.132		1.029	**	0.162	**	0.268	**	0.273		0.842
Retail	0.163		0.990	**	-0.142		-0.299	**	0.259		0.743
Catering	0.230		0.787	**	-0.216	**	0.006		-1.692	**	0.668
Finance	0.136		1.205	**	0.187	*	0.466	**	0.826	**	0.815

Table 8 illustrates that 5 industries among 16 of the additional factor loadings are statistically significant at 5% level and 1 industry at 10%. Among the six significant coefficients, five are negative with high magnitude; for instance, the Construction, Oil&Gas, Personal Services, Business Services and Catering industries. The only statistically significant positive coefficient for the growth rate of confirmed COVID cases is the Finance sector. This finding is deemed to be unanticipated as the hypothesis might assume that the surge of the pandemic should have impaired the cumulative return for all sectors. The cumulative returns of Figure 6 could be a plausible explanation for this phenomenon. We previously noticed that the cumulative return of the Finance sector has doubled between December 2019 and December 2021. This unprecedented increase of returns after the collapse could be mistranslated by the growth rate factor coefficient suggesting investor in the Finance sector has gained positive returns from the growth of new confirmed COVID cases. When comparing the size factor with the one in the original 3 factors model, it is observed that two additional industries have become statistically significant. They are the Agriculture sector and the Catering industry which are positively significant at 10% and negatively significant at 5% respectively. In contrast, the Retail sector lost its significance and the Entertainment sector become significant at 10% level instead of 5% level. Regarding the value factor, it is shown that the significance of the Entertainment sector changes from 10% level to 5% level. However, the Construction and Catering sectors lost both their significance.

SECTION 3: CONCLUSION

The official announcement of the COVID outbreak as a global pandemic by the World Health Organization (WHO) on the 11th of March 2020 triggered dramatically freefall of worldwide financial markets. Due to the unstoppable transmission speed of the virus, numerous countries decided to impose partial or general lockdowns by suspending business activities. Lately, several researchers found out that developing countries suffer bigger repercussions of COVID pandemic than developed countries because they have a weaker hospital system and less mature government fiscal policies. Moreover, papers of Yan (2020), Ichev et al. (2018), Harjoto et al. (2021) and Duan et al. (2020) discovered that smaller size enterprises are more impacted by the pandemic than larger firms since they have weaker capital structure to survive the economic downturns and lockdowns. Indeed, sanitary restrictions represent more complex hurdles to cross for our current service-based economy (Baker et al., 2020). Massive small and medium sized enterprises declared bankruptcy despite of receiving fiscal aids from the government. Global economic recession and uncertainty have triggered anxiety and vulnerability of investors. Consequently, panic selling has destabilized global stock markets (Fetzer et al, 2021; Zaremba et al., 2020). Existing empirical results provided evidence that the increase of COVID confirmed cases and deaths (i.e. bad news) increase the volatility, represented by the rise of standard deviation, in the stock market. Furthermore, stock market is more sensitive to the bad news than the good news (Zhang et al., 2020; He et al.,2020).

Our first research question is to investigate the performance of Fama French 3 factors model in developed Stock Markets during the COVID-19 pandemic. The high R^2 values are generally around 0.9 and the intercepts are statistically insignificant in all three analysed regions. Incorporating either the dummy variable or the growth rate of confirmed cases only changes slightly the intercept or the R^2 values. This suggests that the Fama French 3 risk factors have demonstrated a remarkable explanatory power for the developed stock markets, even during the stressful period such as the coronavirus pandemic. While analysing the summary statistics of our data, we notice portfolios that contain smaller size stocks are more volatile (i.e. higher standard deviation) than those containing bigger size stock. This is in line with the finding of Yan (2020), Ichev et al. (2018), Harjoto et al. (2021) and Duan et al. (2020) that postulates more severe repercussions of the pandemic on the small size enterprises than large size companies. Based on our results, we observe that investors require higher size premium for American portfolios, followed by the Japanese portfolios and European portfolios. Same for the value premium, the risk premium for American portfolios is the highest among the 3 regions followed by the European value premium then the Japanese value premium.

Regarding our second research question, the high R^2 and insignificant intercept values confirm that the Fama French 3 factors have also a good explanatory power on the industry returns in America. Furthermore, regardless of the incorporation of the Dummy or growth rate, all the statistically significant coefficients for industry returns remain negative with high magnitude except the Finance sector's beta which appears to be positive. This could be explained by the unprecedented increase of returns in this sector after the tragic plummet caused by the pandemic. According to our results, the Covid-19 crisis had statistically significant repercussions on the Construction, Oil&Gas, Telecommunication, Personal Services, Business Services and Catering industries in the US. This is in line with the paper of Baker et al (2020) postulating the painful hit of sanitary policies against COVID outbreak to our serviced-based economy. It is worth noting that, in contrast to our belief, the consideration of a COVID variable (i.e. the dummy variable or the growth rate of confirmed cases) does not have statistically significant impacts on the returns of other sectors. This finding is unexpected since we presume that there should have existed a detrimental effect of the pandemic on the industries in the US despite the insignificant factor loadings.

LIMITATIONS

The first limitation is obviously our sample period from January 2012 to December 2021. Despite our database contains 120 datapoints, we should not forget that there is the COVID-19 pandemic did not end in 2021. The second limitation is we only studied equities. In order to have a more complete investigation of the COVID impacts on the stock markets, it is also worth including more asset classes in the analysis. The third limitation is the geographical scope of developed countries. In fact, there are only three selected regions among all the other developed stock markets which are not fully representative. Similarly, the analysis on the American industry returns cannot be generalised to the other developed markets.

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APPENDICES

Appendix 1: Industry definitions in America

INDUSTRY	DEFINITION
Agriculture	Agriculture production, agriculture services, commercial fishing, prepared feeds for animals
Entertainment	Motion picture, video rental, amusement and recreation, dance studios, bands, entertainers, bowling centres, professional sports
Healthcare	Services – Health
Construction	Build construction, general building contractors, operative builders, heavy construction, construction
Mining	Non-Metallic and Industrial Metal Mining:
Oil&Gas	Petroleum and Natural Gas
Utilities	Electric, gas & sanitary services, Electric services, Natural gas transmission & distribution, Electric and other services combined, Gas and other services combined, Misc combination utilities, Water supply
Communication	Telephone communications, Telegraph and other message communication, Radio & TV broadcasters, Cable and other pay TV services, Communications, Communication services (Comsat), Cable TV operators, Telephone interconnect
Personal services	Rooming and boarding houses, Camps and recreational vehicle parks, services
Business services	Commercial printing, Signs & advertising specialties, Services
Software	Computer programming and data processing, information retrieval services, Computer integrated systems design
Transportation	Transportation
Wholesale	Wholesale
Retail	Retail
Catering	Restaurants, Hotels, Motels
Finance	Trading

Appendix 2: Regressions of excess returns regressions on 25 portfolios formed on size and Book-to-Market

$$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 Dummy_t + \epsilon_{it} \quad (2)$$

Model 2 in Europe

	Low	2	3	4	High	Low	2	3	4	High
			β_1					$t(\beta_1)$		
Small	1.007	1.001	0.954	0.909	0.845	33.635	41.625	41.626	41.707	39.308
2	1.074	1.001	1.026	0.977	0.994	41.416	37.457	45.862	44.849	43.974
3	1.104	1.084	1.078	1.042	1.045	34.641	43.840	39.483	41.633	37.946
4	1.041	1.072	1.060	1.059	1.089	39.355	36.324	40.454	37.277	30.792
Big	0.908	0.972	1.069	0.962	1.089	48.274	48.836	49.132	42.200	38.907
			β_2					$t(\beta_2)$		
Small	1.194	1.017	0.912	0.904	0.888	17.020	18.063	16.975	17.714	17.637
2	1.000	1.015	0.990	0.833	0.805	16.451	16.214	18.889	16.323	15.196
3	0.795	0.664	0.713	0.596	0.481	10.656	11.458	11.137	10.173	7.455
4	0.445	0.273	0.314	0.462	0.352	7.182	3.949	5.114	6.946	4.249
Big	-0.314	-0.328	-0.131	-0.128	-0.080	-7.122	-7.043	-2.569	-2.392	-1.217
			β_3					$t(\beta_3)$		
Small	-0.180	-0.051	0.051	0.171	0.451	-3.637	-1.277	1.339	4.755	12.709
2	-0.409	-0.191	0.080	0.248	0.487	-9.546	-4.336	2.160	6.882	13.035
3	-0.449	-0.273	-0.013	0.098	0.543	-8.538	-6.684	-0.278	2.374	11.948
4	-0.546	-0.405	-0.076	0.146	0.555	-12.494	-8.316	-1.757	3.116	9.501
Big	-0.534	-0.388	-0.065	0.275	0.939	-17.189	-11.814	-1.808	7.312	20.334
			β_4					$t(\beta_4)$		
Small	0.436	0.231	0.530	0.406	0.466	1.460	0.962	2.319	1.869	2.176
2	0.319	0.293	-0.290	-0.228	-0.254	1.232	1.101	-1.301	-1.050	-1.127
3	-0.215	-0.730	-0.260	0.071	-0.167	-0.675	-2.963	-0.956	0.284	-0.608
4	-0.339	-0.232	-0.315	-0.433	-0.075	-1.284	-0.789	-1.207	-1.528	-0.211
Big	0.186	-0.182	-0.057	-0.174	0.444	0.994	-0.916	-0.264	-0.767	1.593

			R^2					$s(e)$		
Small	0.936	0.956	0.958	0.961	0.963	1.294	1.039	0.991	0.941	0.929
2	0.950	0.944	0.965	0.965	0.968	1.121	1.155	0.967	0.942	0.977
3	0.925	0.952	0.948	0.954	0.956	1.377	1.068	1.180	1.082	1.190
4	0.935	0.925	0.945	0.943	0.933	1.144	1.275	1.132	1.228	1.529
Big	0.952	0.955	0.961	0.957	0.965	0.813	0.860	0.941	0.985	1.209

Model 2 in United-States

	Low	2	3	4	High	Low	2	3	4	High
			β_1					$t(\beta_1)$		
Small	1.070	0.982	0.937	0.904	0.844	16.312	17.416	31.415	31.449	10.170
2	1.125	0.972	1.016	0.943	1.123	24.905	33.245	35.049	32.606	28.590
3	1.141	1.000	0.986	1.044	1.128	28.612	34.570	31.287	33.479	28.076
4	1.043	1.044	1.038	1.089	1.160	29.137	34.293	30.478	24.352	27.654
Big	1.033	0.919	0.896	0.923	1.276	52.369	39.392	27.397	31.869	24.009
			β_2					$t(\beta_2)$		
Small	1.721	1.361	1.127	1.037	1.301	16.311	15.005	23.486	22.444	9.748
2	1.318	0.915	0.854	0.864	0.885	18.150	19.463	18.316	18.583	14.008
3	0.861	0.584	0.494	0.635	0.772	13.425	12.558	9.738	12.673	11.957
4	0.396	0.212	0.206	0.296	0.390	6.874	4.337	3.755	4.118	5.783
Big	-0.180	-0.230	-0.079	-0.080	0.214	-5.667	-6.134	-1.496	-1.722	2.501
			β_3					$t(\beta_3)$		
Small	-0.299	-0.053	0.283	0.592	0.702	-3.609	-0.748	7.509	16.335	6.706
2	-0.364	0.066	0.342	0.624	0.754	-6.398	1.779	9.350	17.090	15.217
3	-0.369	0.115	0.332	0.559	0.868	-7.334	3.155	8.338	14.216	17.130
4	-0.320	0.122	0.320	0.580	0.850	-7.085	3.184	7.438	10.281	16.079
Big	-0.342	0.014	0.296	0.587	0.834	-13.762	0.477	7.169	16.085	12.442
			β_4					$t(\beta_4)$		
Small	-0.247	-0.469	-0.045	-0.485	1.689	-0.400	-0.883	-0.160	-1.794	2.164
2	-1.065	-0.643	-0.289	-0.420	0.582	-2.509	-2.340	-1.061	-1.543	1.577
3	-0.715	-0.191	-0.678	-0.162	0.169	-1.907	-0.701	-2.288	-0.552	0.447
4	-0.383	-0.145	-0.136	-0.052	-0.510	-1.137	-0.505	-0.424	-0.125	-1.293
Big	0.337	0.137	-0.479	-0.654	-0.011	1.817	0.624	-1.557	-2.404	-0.022
			R^2					s(e)		
Small	0.860	0.861	0.952	0.957	0.761	2.682	2.305	1.220	1.175	3.392
2	0.915	0.946	0.952	0.955	0.939	1.846	1.195	1.185	1.182	1.606
3	0.916	0.939	0.929	0.946	0.937	1.630	1.183	1.289	1.274	1.642
4	0.901	0.925	0.913	0.887	0.923	1.463	1.245	1.392	1.828	1.714
Big	0.961	0.931	0.885	0.927	0.888	0.806	0.954	1.337	1.184	2.173

Model 2 in Japan

	Low	2	3	4	High	Low	2	3	4	High
			β_1					$t(\beta_1)$		
Small	1.290	1.061	0.952	0.912	0.920	19.995	23.609	25.429	29.756	36.500
2	1.245	0.949	0.929	0.938	0.982	16.504	25.266	28.967	33.477	41.428
3	1.102	0.937	0.896	0.930	1.026	20.669	26.805	25.436	32.392	38.487
4	0.919	0.882	0.953	1.076	1.149	18.352	29.229	32.161	33.788	30.003
Big	0.969	0.954	0.927	1.064	1.211	35.363	31.965	34.303	36.140	26.886
			β_2					$t(\beta_2)$		
Small	1.260	1.202	1.099	1.054	0.971	10.277	14.067	15.437	18.096	20.265
2	1.096	0.827	0.816	0.800	0.857	7.645	11.577	13.375	15.013	19.011
3	0.917	0.625	0.582	0.615	0.632	9.043	9.407	8.681	11.265	12.458
4	0.430	0.267	0.252	0.278	0.357	4.519	4.649	4.466	4.589	4.904
Big	-0.314	-0.122	-0.127	-0.271	-0.099	-6.017	-2.148	-2.474	-4.840	-1.156
			β_3					$t(\beta_3)$		
Small	-0.302	-0.054	0.080	0.208	0.352	-3.190	-0.814	1.460	4.626	9.526
2	-0.677	-0.079	0.179	0.310	0.555	-6.113	-1.427	3.813	7.538	15.959
3	-0.454	-0.051	0.140	0.353	0.587	-5.807	-0.996	2.714	8.366	14.996
4	-0.614	-0.144	0.079	0.351	0.595	-8.350	-3.244	1.805	7.510	10.585
Big	-0.585	-0.261	0.128	0.238	0.680	-14.542	-5.969	3.217	5.508	10.282
			β_4					$t(\beta_4)$		
Small	-0.320	-0.269	-0.081	0.406	0.088	-0.537	-0.647	-0.234	1.432	0.376
2	-0.752	0.195	0.780	-0.052	0.050	-1.077	0.560	2.627	-0.201	0.228
3	0.495	0.033	-0.001	-0.249	-0.085	1.003	0.102	-0.004	-0.938	-0.344
4	0.109	-0.449	-0.519	-0.352	-0.096	0.236	-1.608	-1.892	-1.193	-0.271
Big	0.161	0.191	-0.064	-0.113	0.002	0.633	0.692	-0.257	-0.416	0.005
			R^2					s(e)		
Small	0.840	0.879	0.890	0.913	0.936	2.577	1.795	1.496	1.224	1.007
2	0.804	0.879	0.897	0.919	0.946	3.013	1.500	1.281	1.119	0.947
3	0.851	0.880	0.860	0.908	0.934	2.131	1.396	1.408	1.147	1.066
4	0.818	0.889	0.900	0.908	0.891	2.001	1.206	1.184	1.273	1.530
Big	0.928	0.901	0.909	0.920	0.875	1.095	1.192	1.080	1.176	1.800

Appendix 3: Regressions of excess returns regressions on 25 portfolios formed on size and Book-to-Market

$$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_5 Growth_t + \epsilon_{it} \quad (3)$$

Model 3 in Europe

	Low	2	3	4	High	Low	2	3	4	High
			β_1					$t(\beta_1)$		
Small	1.015	1.002	0.956	0.906	0.843	32.368	39.993	39.274	39.604	37.146
2	1.087	1.001	1.022	0.980	0.984	40.390	35.903	43.671	43.159	41.931
3	1.073	1.070	1.063	1.062	1.042	33.759	40.341	37.767	42.108	36.369
4	1.035	1.064	1.057	1.044	1.081	37.416	34.693	38.596	35.312	29.482
Big	0.909	0.974	1.059	0.962	1.094	46.354	47.038	47.359	40.538	37.235
			β_2					$t(\beta_2)$		
Small	1.208	1.020	0.913	0.897	0.884	16.607	17.547	16.175	16.910	16.781
2	1.024	1.015	0.983	0.839	0.786	16.400	15.689	18.112	15.929	14.441
3	0.736	0.638	0.683	0.635	0.475	9.986	10.380	10.463	10.862	7.150
4	0.433	0.259	0.309	0.433	0.336	6.753	3.637	4.868	6.319	3.946
Big	-0.312	-0.324	-0.152	-0.127	-0.071	-6.849	-6.735	-2.939	-2.309	-1.043
			β_3					$t(\beta_3)$		
Small	-0.185	-0.055	0.038	0.158	0.437	-3.706	-1.386	0.971	4.324	12.078
2	-0.407	-0.199	0.084	0.256	0.485	-9.487	-4.473	2.262	7.064	12.971
3	-0.468	-0.264	-0.018	0.112	0.545	-9.231	-6.256	-0.402	2.791	11.937
4	-0.542	-0.405	-0.070	0.145	0.550	-12.298	-8.282	-1.600	3.084	9.411
Big	-0.538	-0.382	-0.072	0.280	0.931	-17.190	-11.555	-2.028	7.399	19.889
			β_5					$t(\beta_5)$		
Small	0.099	-0.002	-0.071	-0.159	-0.131	0.457	-0.013	-0.423	-1.001	-0.832
2	0.246	-0.051	-0.037	0.105	-0.190	1.319	-0.265	-0.230	0.667	-1.168
3	-0.700	-0.191	-0.326	0.472	-0.046	-3.177	-1.038	-1.668	2.699	-0.230
4	-0.093	-0.138	-0.006	-0.291	-0.195	-0.487	-0.648	-0.030	-1.421	-0.767
Big	-0.005	0.092	-0.256	0.038	0.033	-0.034	0.641	-1.654	0.232	0.160

			R^2					s(e)		
Small	0.935	0.956	0.956	0.960	0.962	1.305	1.043	1.013	0.952	0.945
2	0.951	0.944	0.965	0.965	0.968	1.120	1.160	0.974	0.944	0.977
3	0.931	0.949	0.949	0.957	0.956	1.323	1.103	1.171	1.049	1.192
4	0.934	0.925	0.944	0.943	0.934	1.151	1.276	1.139	1.230	1.525
Big	0.952	0.955	0.962	0.957	0.965	0.816	0.862	0.930	0.987	1.222

Model 3 in United-States

	Low	2	3	4	High		Low	2	3	4	High
			β_1						$t(\beta_1)$		
Small	0.997	1.001	0.953	0.893	0.855		14.643	16.562	30.009	28.603	9.411
2	1.063	0.962	1.031	0.975	1.055		22.215	29.982	33.324	32.364	27.467
3	1.100	1.006	1.011	1.035	1.123		25.886	32.378	29.963	30.940	26.034
4	1.024	1.049	1.033	1.009	1.115		26.661	32.077	28.240	23.159	25.267
Big	1.037	0.921	0.901	0.905	1.266		48.312	36.699	25.456	28.577	22.214
			β_2						$t(\beta_2)$		
Small	1.692	1.363	1.132	1.029	1.320		16.556	15.025	23.750	21.963	9.683
2	1.286	0.905	0.857	0.872	0.865		17.905	18.805	18.444	19.291	15.020
3	0.839	0.585	0.497	0.630	0.772		13.167	12.537	9.801	12.564	11.930
4	0.385	0.213	0.202	0.267	0.369		6.684	4.333	3.688	4.079	5.574
Big	-0.175	-0.228	-0.081	-0.093	0.210		-5.439	-6.068	-1.529	-1.948	2.455
			β_3						$t(\beta_3)$		
Small	-0.384	-0.021	0.303	0.588	0.683		-4.487	-0.273	7.589	14.985	5.987
2	-0.420	0.065	0.366	0.670	0.658		-6.987	1.623	9.417	17.713	13.645
3	-0.407	0.126	0.375	0.551	0.858		-7.617	3.219	8.848	13.109	15.837
4	-0.336	0.130	0.315	0.483	0.806		-6.964	3.171	6.861	8.816	14.526
Big	-0.344	0.013	0.311	0.578	0.822		-12.749	0.415	6.994	14.526	11.475
			β_5						$t(\beta_5)$		
Small	-1.091	0.344	0.247	-0.118	-0.016		-2.844	1.009	1.378	-0.670	-0.032
2	-0.827	-0.084	0.266	0.528	-1.118		-3.067	-0.464	1.525	3.114	-5.169
3	-0.558	0.106	0.457	-0.122	-0.103		-2.334	0.607	2.405	-0.649	-0.424
4	-0.250	0.080	-0.071	-1.214	-0.620		-1.154	0.437	-0.346	-4.945	-2.493
Big	0.025	0.005	0.130	-0.200	-0.158		0.203	0.037	0.653	-1.119	-0.492
			R^2						s(e)		
Small	0.869	0.861	0.953	0.956	0.752		2.594	2.303	1.210	1.189	3.461
2	0.917	0.943	0.953	0.958	0.950		1.823	1.222	1.179	1.147	1.462
3	0.917	0.939	0.929	0.947	0.937		1.618	1.183	1.286	1.273	1.642
4	0.901	0.925	0.913	0.907	0.926		1.463	1.245	1.393	1.660	1.681
Big	0.959	0.931	0.883	0.924	0.888		0.817	0.956	1.348	1.206	2.171

Model 3 in Japan

	Low	2	3	4	High		Low	2	3	4	High
			β_1						$t(\beta_1)$		
Small	1.279	1.055	0.951	0.911	0.922		19.749	23.319	25.167	29.206	36.326
2	1.238	0.943	0.928	0.941	0.987		16.221	24.942	27.848	33.340	41.571
3	1.088	0.934	0.905	0.931	1.028		20.380	26.504	25.834	31.982	38.151
4	0.913	0.880	0.953	1.073	1.134		18.106	28.632	31.375	33.283	30.330
Big	0.971	0.961	0.924	1.061	1.207		35.149	32.293	33.962	35.764	26.587
			β_2						$t(\beta_2)$		
Small	1.242	1.194	1.100	1.042	0.976		10.135	13.948	15.373	17.646	20.298
2	1.101	0.807	0.792	0.809	0.868		7.624	11.281	12.550	15.153	19.314
3	0.867	0.618	0.606	0.624	0.637		8.580	9.259	9.129	11.327	12.500
4	0.411	0.273	0.265	0.279	0.322		4.309	4.695	4.617	4.572	4.552
Big	-0.311	-0.109	-0.134	-0.276	-0.110		-5.951	-1.929	-2.595	-4.911	-1.281
			β_3						$t(\beta_3)$		
Small	-0.306	-0.054	0.081	0.201	0.353		-3.261	-0.832	1.481	4.443	9.601
2	-0.669	-0.087	0.165	0.314	0.559		-6.053	-1.582	3.426	7.671	16.246
3	-0.475	-0.054	0.149	0.357	0.589		-6.145	-1.057	2.927	8.479	15.108
4	-0.621	-0.138	0.087	0.354	0.583		-8.507	-3.107	1.979	7.581	10.769
Big	-0.585	-0.258	0.126	0.237	0.676		-14.616	-5.990	3.193	5.520	10.280
			β_5						$t(\beta_5)$		
Small	-0.514	-0.305	-0.036	0.028	0.127		-1.241	-1.052	-0.149	0.142	0.781
2	-0.366	-0.221	0.045	0.135	0.215		-0.749	-0.914	0.209	0.746	1.415
3	-0.582	-0.115	0.419	0.003	0.042		-1.703	-0.509	1.869	0.018	0.243
4	-0.274	-0.162	-0.072	-0.196	-0.675		-0.850	-0.826	-0.371	-0.951	-2.820
Big	0.136	0.349	-0.152	-0.152	-0.194		0.771	1.833	-0.873	-0.798	-0.669
			R^2						s(e)		
Small	0.841	0.880	0.890	0.912	0.937		2.563	1.790	1.496	1.235	1.005
2	0.803	0.880	0.891	0.919	0.947		3.021	1.497	1.319	1.117	0.939
3	0.853	0.880	0.864	0.908	0.934		2.114	1.395	1.387	1.151	1.066
4	0.819	0.887	0.897	0.908	0.898		1.995	1.216	1.202	1.276	1.480
Big	0.929	0.904	0.909	0.920	0.875		1.094	1.177	1.076	1.174	1.797

Abstract :

This thesis aims to study two research questions. On one hand, this thesis evaluates the performance of the Fama French 3 factors model in developed stock markets during the COVID-19 pandemic. In particular, the study investigates the functionality of the Fama French 3 factors model during the turbulent COVID-19 period in the European, American and Japanese stock markets. On the other hand, the Fama French 3 factors model is deployed to analyse the potential impacts of the pandemic on industry returns in America. The model regressions derive monthly data from January 2012 to December 2021. The empirical results suggest a strong capacity of the Fama French 3 factors in explaining the stock returns in all three studied stock markets, even during the unsettled period of coronavirus. The model outputs show more severe repercussions of the coronavirus on the small size enterprises than large size companies. When incorporating COVID variables in the basic 3 risk factors model in America, the result shows that only the returns of service-related sectors are statistically affected by the pandemic factor.

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