

## THE IMPACT OF COVID-19 TO GLOBAL PHARMACEUTICALS AND BIOTECHNOLOGY COMPANY STOCKS RETURNS

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### ABSTRACT

**Purpose** – A mix of legacy drug makers and small startups have stepped forward with plans to develop vaccines or treatments that target the infection caused by Covid-19. In this paper, we examine whether COVID-19 related news triggers investment to pharma and biotech companies.

**Methodology** We investigate the news impact of the pandemic on global pharmaceuticals and biotechnology industry stock returns by utilizing EGARCH models and News Impact Curves

**Findings**- Due to our results, there are outstanding companies such as Gilead with its remdesivir which was originally developed to treat the Ebola virus and Dynavax partnering with vaccine developer companies to use its technology.

**Conclusion**- The asymmetry in the NICs for the favor of good news suggests that companies like Gilead and Dynavax are priced by the market with an expectation to find the cure or play an important part in this process.

**Keywords:** Covid-19, stock returns, pharmaceuticals, biotechnology.

**JEL Codes:** C58, G14, G15

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### 1. INTRODUCTION

Many epidemic diseases have occurred worldwide in history. There is abundant literature as regards the social, political, and economic effects of diseases. The literature review shows us that many epidemics have resulted in the deaths of millions of people around the world for centuries.

Some of the most socially and economically affected epidemics are namely; the Black Death, known as the Pestilence, between 75 and 100 million people who died between 1346 and 1352; the Viral hemorrhagic fever, in which about 50% of the population in Mexico between 1545-1548 died and 2-25 million people died; the Cholera epidemic, in which approximately 1 million people died in Russia between 1852-1860 and a total of 800 thousand people in the continents of Europe Asia and Africa between 1899-1923; HIV AIDS, which is the first seen in the Congo basin, where approximately 30 million people have died since 1960, Spanish Flu, in which about 75 million people died in the worldwide between 1918-1920 years, SARS(Coronavirus) from 2002 to 2003, and epidemic diseases like Swine influenza, Avian flu, and Ebola (Sherman, 2016).

In December 2019, pneumonia was observed in various patients that developed for no specific reason and did not respond to treatment and vaccines. A respiratory disease outbreak caused by a new coronavirus, called COVID-19, was first detected in

Wuhan, China's Hubei Province. With the virus detected in tens of thousands of people in a short time in China, Chinese health officials stated that the infection spread from person to person. COVID-19 was declared as a global epidemic by the World Health Organization on March 11 2020, after reporting virus cases in several countries in Europe, North America and Asia-Pacific in January and February. As of April 10, 2020, the total number of patients in 212 countries worldwide is 1 million 619 thousand, the total number of deaths is 97,056<sup>1</sup>.

After the COVID-19, the Chinese economy slowed down with production cuts, disrupted the functioning of global supply chains, and gave the first warning of a global depression. Since China has both a producer and consumer role, it has seriously affected the real sectors and the stock market as well as its economy. Depending on the inputs from China, companies' production started to shrink regardless of their size. After the transportation became limited among countries, global economic activities slowed down even more. High-risk industries such as manufacturing, tourism, travel, transportation, and automotive sectors have been among the sectors most struggling and most affected by the epidemic.

According to the Organization for Economic Cooperation and Development (OECD), it has stated that the world economy will face the lowest growth rate since 2009 due to the coronavirus outbreak this year. Especially with the expansion of the epidemic in China, the closure of factories in the Wuhan region and the dismissal of a significant number of workers to reduce the dangerous effect of the virus harmed the Chinese economy. Along with the decrease in production in China, the shrinkage in raw material and energy demand has affected the world trade volume dramatically. Along with the decrease in production in China, the shrinkage in raw material and energy demand has affected the world trade volume dramatically. Afterward, the spread of the virus to Europe and America caused similar effects to be seen in these economies as well. For instance, in the USA, unemployment applications reached 10 million people in two weeks. The transition to partial quarantine after the outbreak caused demand shock. Supply shock has occurred due to the breakage of chains in the supply channel. On the other hand, the demand for many various sectors mentioned above decreased drastically. As a result, inevitably, the reduction in world trade volume and critical disruptions in production will adversely affect the world economy. Because of all these, it is expected that negative growth figures dominate many countries. While the demand for sectors such as automotive, tourism, and financial services decreased, medical supply services, e-commerce, food sectors' demand increased excessively.

Some panic among consumers and companies in all markets disrupted their usual consumption habits and created market anomalies. Global financial markets also responded to changes, and global stock indices diminished. The evolution of the disease and the uncertainty of its economic impact make it difficult for policymakers to formulate an appropriate macroeconomic policy response. All this proves that even an epidemic can significantly affect the global economy in the short term. Almost all economists address the importance of investing more in public health systems in all economies, especially in less developed economies where health systems are less developed, and the population density is high. The decisions taken by investors in line with the bad news spread reveal a financial contagion just like in infectious diseases. Contagion in financial sectors is the spread of the reaction of several sectors and regions to a shock in an economy to all financial sectors or countries with a strong financial structure. As can be seen from the previous global financial crises, financial sectors are sensitive to shocks. (Tiryaki and Ekinci, 2015).

Of course, the developments in this real economy will inevitably increase the volatility in the financial markets and decrease the risk appetite. Thus, the S&P 500 index, which is the best indicator of US stock markets, decreased by 35 percent even though there was a slight recovery afterward. Decreasing appetite for taking risks in the markets and increasing willingness to avoid risky investments led to a drop in asset prices in financial markets. The destruction in asset prices decreased the collateral values as a result of the mainly leveraged transactions in the financial markets and increased the collateral completion requests called Margin-Call. That exceedingly increased the need for liquidity in financial markets, and central banks of developed countries, especially the Fed, had to infuse tremendous amounts of liquidity into the markets by increasing their purchases. These significant changes in exchanges can affect many investments. After the COVID-19 outbreak, FTSE, Dow Jones Industrial Average, and Nikkei have seen massive drops. Dow and FTSE have recently seen their most prominent daily decline since 1987.

All these volatility impacts are closely related to the business of global pharmaceutical and biotechnology deeply related to infectious diseases. In this sense, it is essential to measure how infectious disease outbreaks influence the market behavior and stock performance of the companies operating in these sectors. In this period, GlaxoSmithKline decided to invest \$250m in San Francisco-based start-up Vir Biotechnology to develop antibodies that could be used to treat coronavirus. Due to this

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<sup>1</sup> (<https://www.worldometers.info/coronavirus/>)

announcement, Vir share hiked up almost 20 percent to \$34.75 in mid-morning trading in New York. In addition, Pfizer Inc. informed about its plans to support the development and distribution of BioNTech SE's BNTX COVID-19 vaccine candidate. BioNTech targets to start the clinical trials across the US and Germany in late April 2020.

Moreover, three drugs with the potential to treat COVID-19 have received the most public attention. Gilead's remdesivir, which was originally developed to treat the Ebola virus, is in late-stage clinical studies and could be the most promising treatment. Finally, the biopharmaceutical company Dynavax Technologies decided to allow usage of its adjuvant technology by partnering with companies that develop COVID-19 vaccines, alongside working on the vaccine development with the University of Queensland. In this context, we investigated whether news related to COVID-19 triggered investment in pharmaceutical companies, namely Abb Vie Inc, Bristol Myers Squibb, Chinext, Dynavax Technologies, Gilead Sciences, and Pfizer by utilizing volatility models and new impact curves. Finally, this paper is a preliminary study for upcoming research papers after the impact of COVID-19 on financial markets, pharmaceuticals and biotechnology companies becomes more visible.

## **2. LITERATURE REVIEW**

Zeren and Hızarcı have exposed the potential effects of coronavirus pandemic on stock exchanges that were reviewed with Maki (2012) cointegration test by using COVID-19 daily total death, and COVID-19 daily total case. Research results show that all stock markets considered with total death act in unison over the long term. Furthermore, after the investigations, it can be said that even though total cases of COVID-19 have a cointegration association with SSE, KOSPI, and IBEX35, have no cointegration association with FTSE MIB, CAC40, and DAX30. In these circumstances, it is suggested that investors tend to derivative markets, which are more reliable than the stock market, and to stock markets of other less risky countries (Zeren, and Hızarcı, 2020).

Spectral causality and the well-known Granger causality model have been tested to see the effects of the COVID-19 on the stock markets, such as Shanghai Se A Share, France Cac 40, Dax 30, etc. These countries' stocks rank as the world's leading markets. Moreover, COVID-19 has interpreted as a "black swan" event for the financial markets. As a result of the analysis, it has seen that the Shanghai Se A index had a short-term effect on global markets at the beginning of the epidemic (Morales, and Andresosso, 2020).

Researchers, who predict that COVID-19 will become a dangerous global pandemic before being declared an epidemic by the World Health Organization, have analyzed the effects of various situations on macroeconomic results, and financial markets in a global dynamic stochastic general equilibrium (DSGE), and computable general equilibrium (CGE) models. These models demonstrate that the global economy has dramatically influenced in the short term (McKibbin, and Fernando, 2020).

Event study analysis and regression-based methods have been implemented in another research that investigated the investor's impression on the stocks of pharmaceutical companies in the USA, which was steered by media news about global pandemics. In this examination, 102 drug companies listed on the New York Stock Exchange (NYSE) or NASDAQ, and S&P500 Drug index American Deposit Receipts (ADR) have analyzed. After the results of the research, disease-related news (DRN) has a positive and substantial impact on the stock returns of pharmaceutical companies. Besides, these impacts of the disease news last several days. The news about the disease caused fear and anxiety among investors. The index, which is affected by the fear of investors, affects to pharmaceutical companies, and returns of the stocks tremendously negatively (Donadelli et al, 2017). Besides, in another research, they also analyzed the financial returns of the top 10 pharmaceutical companies in the USA, using all historical data on serious infectious diseases considered epidemic by the World Health Organization. In this study, its negative impacts have also mentioned (Donadelli et al, 2015).

In this study analyzing the consequences of the SARS outbreak, the association between the Chinese and Asian (Hong Kong, Taiwan, Singapore, Japan) exchanges have examined using the cointegration model. According to the consequences of the research, it has observed that the co-integration relationship that changed over time in the total stock price indices between China and Asian countries weakened. Consequently, investors can have achieved arbitrage gains by portfolio diversification amongst the mentioned countries during disruptive pandemic infections (Chen, M. P. et al, 2018).

Taiwan, officially the Republic of China, is so essential country for this research since it has faced several epidemics, such as dengue fever, enter virus 71, H1N1, and SARS in the decade. In this analysis, a total of 75 observation numbers from 38 biotechnology companies have examined, and the expected return has acquired from the ordinary least squares (OLS) method. When the relationship between biotechnology companies' financial reports and abnormal returns is analyzed, it can be said to have a significant effect (Wang Y. et al, 2013).

Another article investigating the impacts of the SARS outbreak, one of the various pandemic diseases, has studied its effects on the Taiwan stock exchange. In this article, it has concluded that unlike the other sectors, such as tourism, and retail, the biotechnology sector received positive shocks from the effects of the SARS crisis by using the GARCH method. Moreover, investors can buy stocks, especially of the biotechnology sectors, and gain investment profit during the SARS crisis. (Chen, C. D. et al, 2009)

The event study methodology (ESM), and ARCH, GARCH, and EGARCH models have used in a study investigating the impact of the SARS outbreak on the Taiwan Stock Exchange and hotels' stock prices. The findings of the study demonstrated that hotel share prices are sensitive and respond to outbreaks. Moreover, most of the sectors, especially the tourism sector, have damaged along with the SARS (Chen M.H. et al, 2007). Moreover, Keogh-Brown et al emphasized the fact that countries' economies are extremely sensitive to the strategies and macroeconomic policies implemented in response to a pandemic (Keogh-Brown et al, 2010).

In 2004, unlike other similar studies, the SARS virus, which negatively affects China, and Vietnam stocks, has been found to have no negative impression on the stock markets of other infected countries such as Canada, Indonesia, the Philippines, Singapore, and Thailand. In this study, pioneer stock indices, non-SARS period indices, and S&P 1200 global index have compared. Besides, conventional t-tests and non-parametric Whitney tests have used (Nippani, and Washer, 2004).

In a study looking at the effect of swine flu (H1N1), panel data analysis and Monte Carlo simulation have implemented. The tourism industry has a substantial contribution to Sarawak's economy and its GDP. Thus, 10 major markets in Sarawak tourism have used in this research. Furthermore, it can be said that shocks are not permanent in the short term. Even though these markets had faced lots of shocks, they recovered themselves quickly over and over (Solarin, 2015).

The MONASH-Health model was applied to analyze the economic impacts of swine influenza (H1N1) pandemic on the Australian macroeconomy. This also analysis supports that there is a notable effect of the H1N1 pandemic in the short term. However, the critical point is that the order of stationarity of physical capital and labor (Verikios et al, 2012).

All these literature reviews show us that pandemic diseases have serious effects not only on health but also on the world economy.

### 3. METHODOLOGY

One model that allows for asymmetric effect of news is the EGARCH model. One problem with a standard GARCH model is that it is necessary to ensure that all the estimate coefficients are positive. Nelson (1991) proposed a specification that does not require non-negativity constrains.

Consider:

$$\ln(h_t) = \alpha_0 + \alpha_1 \left( \frac{\varepsilon_{t-1}}{h_{t-1}^{0.5}} \right) + \lambda_1 \left| \frac{\varepsilon_{t-1}}{h_{t-1}^{0.5}} \right| + \beta_1 \ln(h_{t-1}) \quad [1]$$

Equation (1) is called the exponential-GARCH or EGARCH model. There are three interesting features to notice about EGARCH model:

1. The equation for the conditional variance is in log-linear form. Regardless of the magnitude of  $\ln(h_t)$ , the implied value of  $h_t$  can never be negative. Hence, it is permissible for the coefficients to be negative.
2. Instead of using the value of  $\varepsilon_{t-1}^2$ , the EGARCH model uses the level of standardized value of  $\varepsilon_{t-1}^2$  [ i.e.,  $\varepsilon_{t-1}^2$  divided by  $(h_{t-1})^{0.5}$  ]. Nelson argues that this standardization allows for a more natural interpretation of the size and persistence of shocks. After all, the standardized value of  $\varepsilon_{t-1}^2$  is a unit-free measure.
3. The EGARCH model allows the leverage effects. If  $\varepsilon_{t-1}^2/(h_{t-1})^{0.5}$  is positive, the effect of the shock on the log of conditional variance is  $\alpha_1 + \lambda_1$ . If  $\varepsilon_{t-1}^2/(h_{t-1})^{0.5}$  is negative, the effect of the shock on the log of the conditional variance is  $-\alpha_1 + \lambda_1$ .

The trade-off between future risks and asset returns are the essence of most financial decisions. Risk mainly composes of two factors such as volatilities and correlations of financial assets. Since the economy changes frequently and new information is distributed in the markets second moments evolve over-time. Consequently, if methods are not carefully established to update estimates rapidly then volatilities and correlations measured using historical data may not be able to catch differentiation in risk (Cappiello et. all, 2006).

If we consider EGARCH models, the news impact curve has its minimum at  $\varepsilon_{t-1}=0$  and is exponentially increasing in both directions but with different parameters. The news impact curves are made up by using the estimated conditional variances equation for

the related model as such the given coefficient estimates and with the lagged conditional variance set to the unconditional variance.

Consider EGARCH (1,1)

$$\ln(h_t) = \alpha_0 + \beta \ln(h_{t-1}) + \alpha_1 z_{t-1} + \gamma(|z_{t-1}|) - E(|z_{t-1}|) \tag{2}$$

where  $z_t = \varepsilon_t / \sigma_t$ . The news impact curve is

$$h_t = \begin{cases} A \exp\left[\frac{\alpha_1 + \gamma}{\sqrt{h_t}}\right] & \text{for } \varepsilon_{t-1} > 0 \\ A \exp\left[\frac{\alpha_1 - \gamma}{\sqrt{h_t}}\right] & \text{for } \varepsilon_{t-1} < 0 \end{cases} \tag{3}$$

$$A \equiv h_t^\beta \exp[\alpha_0 - \gamma\sqrt{2/\pi}] \tag{4}$$

$$\alpha_1 < 0 \quad \alpha_1 + \gamma > 0 \tag{5}$$

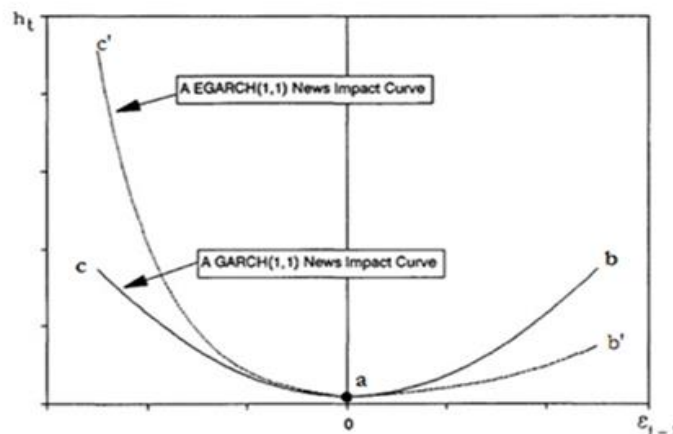
An important characteristic of asset prices is that “bad” news has more persistent impact on volatility than “good” news has. Most of the stocks has a strong negative correlation between the current return and the future volatility. In this context we can define leverage effect as such volatility tends to decrease when returns increase and to increase when returns decrease.

The idea of the leverage effect is exhibited in the figure below, where “new information” is defined and measured by the size of  $\varepsilon_{t-1}$ . If  $\varepsilon_{t-1}=0$ , expected volatility ( $h_t$ ) is 0. Actually, any news increases volatility but if the news is “good” (i.e., if  $\varepsilon_t$  is positive), volatility rises from point *a* to point *b* along *ab* curve (or *ab'* for EGARCH model). However, if the news is “bad”, volatility rises from point *a* to point *c* along *ac* curve (or *ac'* for EGARCH model). Since *ac* and *ac'* are steeper than *ab* and *ab'*, a positive  $\varepsilon_t$  shock will have a lower impact on volatility than a negative shock of these same magnitude (Figure 1).

Asymmetric volatility models are the most interesting approaches in the literature since good news and bad news have different predictability for the future volatility. Overall, Chen and Ghysels (2010) found that partly good (intra-daily) news decreases volatility (the next day), while both very good news which is unusual high intra-daily positive returns, and bad news which is negative returns increase volatility. However, the latter has a more severe impact over longer horizons the asymmetries fade away.

The news impact curve illustrates the impact of previous return shocks on the return volatility which is implicit in a volatility model.

Figure 1: News Impact Curves



#### 4. DATA AND PRELIMINARY ANALYSIS

The study covers daily closing prices for AbbVie Inc<sup>2</sup> (**ABBV**), Bristol Myers Squibb (**BMJ**)<sup>3</sup>, Chinext<sup>4</sup> (**CHINEXT**), Dynavax Technologies<sup>5</sup> (**DVAX**), Gilead Sciences<sup>6</sup> (**GILD**), Pfizer (**PFE**). Daily data for all assets have been taken from Thompson Reuters Eikon. The time span for the study runs from 01 January 2015 to 30 March 2020.

Figure 1: Closing Price Graph of the Dataset

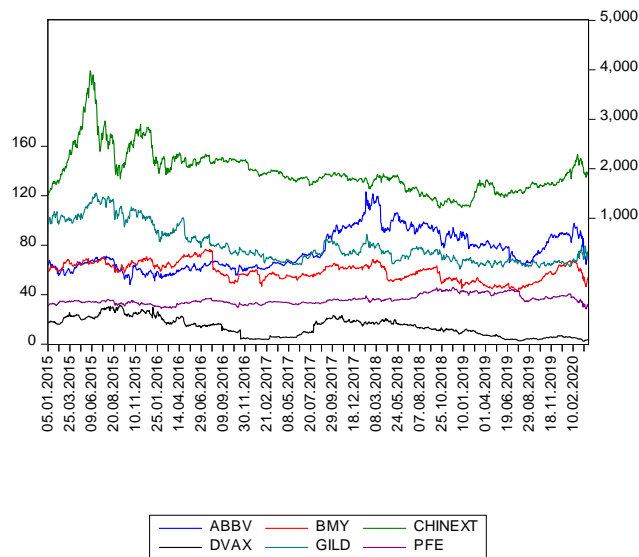


Table 1 illustrates the descriptive statistics of the return of the series. As evident from Table 1, returns of all series are negatively skewed and the kurtosis is much higher than 3 for all the cases. This is indicative of the deviation of series from the normal distribution which is also supported with Jarque-Bera statistics. Further, the stationarity of the variables has been examined using the Augmented Dickey-Fuller (ADF) unit root test. The null hypothesis of the unit root is rejected for all return series.

<sup>2</sup> AbbVie is an American publicly traded biopharmaceutical company founded in 2013. It originated as a spin-off of Abbott Laboratories

<sup>3</sup> Bristol Myers Squibb Company is an American pharmaceutical company, headquartered in New York City. Bristol Myers Squibb manufactures prescription pharmaceuticals and biologics in several therapeutic areas, including cancer, HIV/AIDS, cardiovascular disease, diabetes, hepatitis, rheumatoid arthritis and psychiatric disorders.

<sup>4</sup> ChiNext is a NASDAQ-style subsidiary of the Shenzhen Stock Exchange. The first batch of firms started trading on ChiNext on October 30, 2009. As of June 2015, there were 464 firms listed on ChiNext. ChiNext aims to attract innovative and fast-growing enterprises, especially high-tech firms

<sup>5</sup> Dynavax Technologies Corporation (Nasdaq: DVAX) is a fully-integrated biopharmaceutical company focused on leveraging the power of the body's innate and adaptive immune responses through Toll-like Receptor (TLR) stimulation. Dynavax develops, and commercializes novel vaccines.

<sup>6</sup> Gilead Sciences, Inc., is an American biotechnology company that researches, develops and commercializes drugs. The company focuses primarily on antiviral drugs used in the treatment of HIV, hepatitis B, hepatitis C, and influenza, including Harvoni and Sovaldi.

Table 1: Descriptive Statistics

	<b>RABBV</b>	<b>RBMV</b>	<b>RCHINEXT</b>	<b>RDVAX</b>	<b>RGILD</b>
<b>Mean</b>	6.72E-05	-0.000192	0.000161	-0.000983	-0.000174
<b>Median</b>	0.000946	0.000815	0.000000	0.000000	0.000306
<b>Maximum</b>	0.128985	0.059407	0.06914	0.538546	0.083497
<b>Minimum</b>	-0.177363	-0.174176	-0.093319	-1.040018	-0.090087
<b>Std. Dev.</b>	0.01941	0.017185	0.020966	0.055971	0.017102
<b>Skewness</b>	-1.077872	-2.175612	-0.584761	-4.082499	-0.351434
<b>Kurtosis</b>	16.34614	20.58435	5.818517	110.6006	7.545792
<b>Jarque-Bera</b>	9404.863	16885.67	479.1707	599209.1	1088.768
<b>Probability</b>	0	0	0	0	0
<b>ADF Tests (Level)</b>	-34.91	-36.65	-33.58	-39.13	-36.74

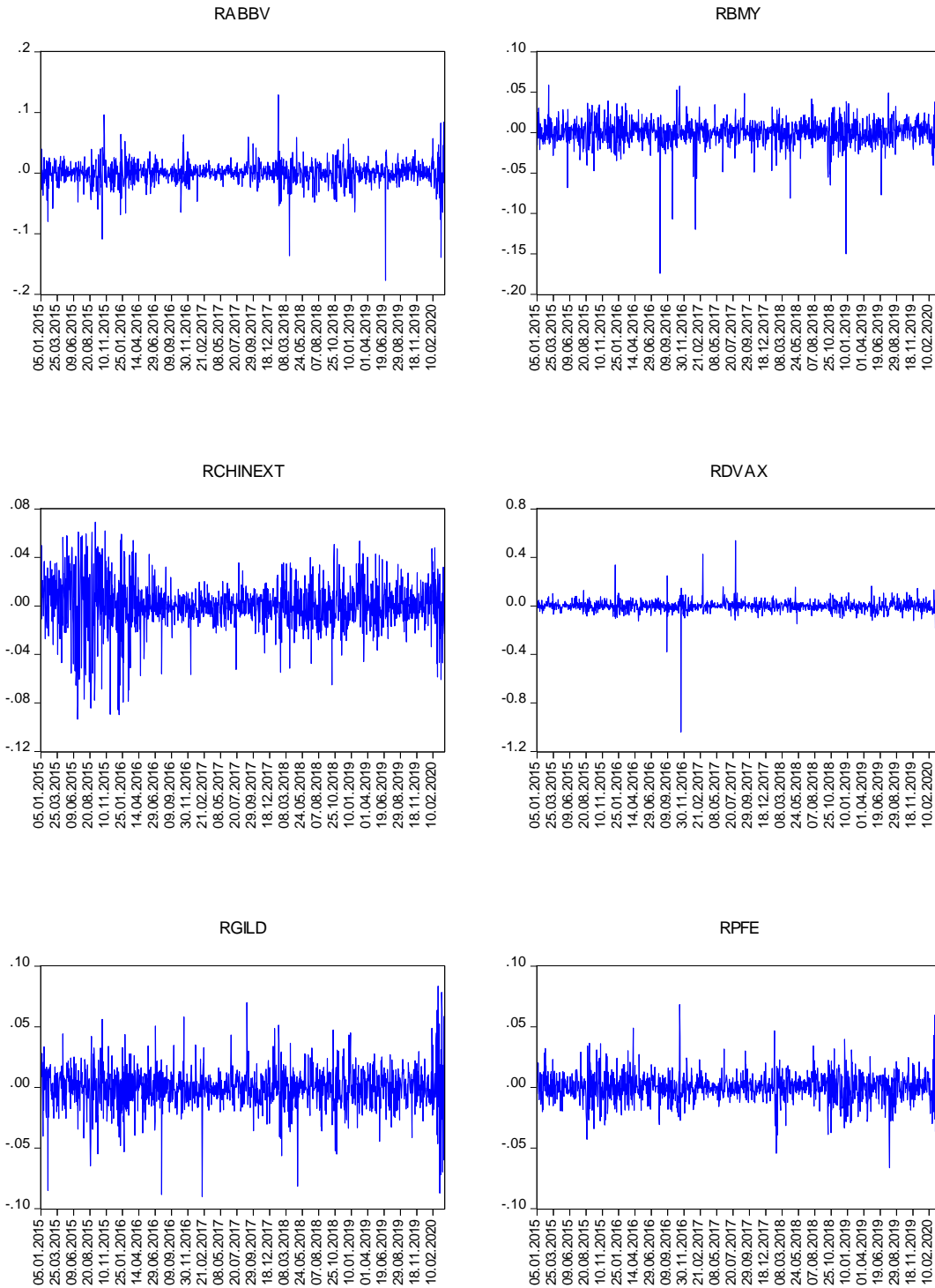
Notes: Betw een parenthesis: p-values. The number of observations for first period is 1235

JB are the empirical statistics for Jarque Bera tests for normality based on skew ness and kurtosis

ADF Tests refer to Augemented Dickey Fuller test for the presence of unit root for long differences (returns)

Returns of all series are calculated by taking the first differences of the logarithm of the two successive prices i.e.  $r_t = \log(P_t/P_{t-1})$  which are RABBV, RBMV, RCHINEXT, RDVAX, RGILD, and RPFE. Time-series graphs of the returns have been illustrated which exhibits vividly how volatility has varied in the last three months in Figure 3. It is also visible that industry index Chinext experienced huge volatility clustering in 2015 due to the Chinese stock market bubble burst. A dummy variable for the COVID-19 outbreak is also created and included into the models. The period after the first case was announced by the Chinese government takes the value of "1" till the end of the dataset period and "0" before the announcement back to 01 January 2015.

Figure 2: Time Series Graphs of the Returns





## 5. EMPIRICAL RESULTS

Having performed unit root tests the next step is to run different versions of EGARCH models for all selected companies. In Table 2 the results of multivariate EGARCH models indicate that coefficients of the COVID-19 dummy variable are positive and significant at %1 significance level in the mean equation of Chnext while it is negative and significant at %1 significance level in the mean equation of Dynavax. On 22<sup>nd</sup> of February 2020, Shenzhen's technology-focused ChiNext index increased 22 percent which was the most among more than 300 leading benchmarks tracked by Bloomberg. Technology and internet companies, which are set to benefit from higher spending by consumers forced to stay indoors because of the viral outbreak were the main drivers of this hike. However, what is more important for our study is healthcare and biotechnology stocks which have also rallied on hopes that these companies will develop coronavirus treatments or get more business owing to the epidemic.

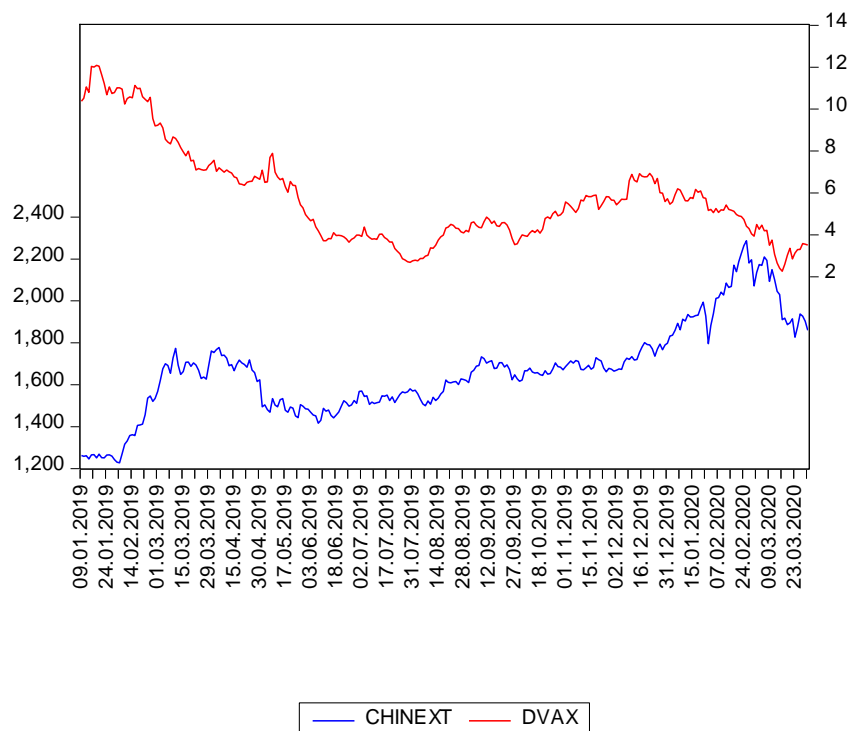
**Table 2: EGARCH Models**

	RCHINEXT				RGILD				RDVAX			
	Mean Equation		Variance Equation		Mean Equation		Variance Equation		Mean Equation		Variance Equation	
	coefficient	z-stats	coefficient	z-stats	coefficient	z-stats	coefficient	z-stats	coefficient	z-stats	coefficient	z-stats
C	-0.7796	-0.0004			0.0892	0.0892			0.0002	0.2159		
RGILD	4.9369	0.1134							0.1617	3.4512	-10.9079	-7.6186
RABBV												
RCHINEXT					0.1016	0.1016	-1.6152	-4.0556	0.1448	4.4927		
RDVAX					0.0180	0.0180						
RBMV							-2.1525	-4.8664	0.2746	5.9438	0.0685	2.5689
RPFE									0.1476	1.5158	-24.0989	-14.7944
COV19	1.3744	0.0029	0.0245	3.0877			0.0481	6.0816	-0.0072	-1.9431	0.2490	4.3727
$\alpha_0$			-0.1204	-6.3153			0.1692	-2.8023			-2.1743	-13.7551
$\alpha_1$			<b>-0.0161</b>	<b>-1.8935</b>			<b>0.0541</b>	<b>5.1276</b>			<b>0.1848</b>	<b>8.6462</b>
$\lambda_1$			0.0928	7.2087			0.0503	4.4253			0.8666	22.1568
$\beta_1$			<b>0.9938</b>	<b>597.1417</b>			<b>0.9843</b>	<b>148.8343</b>			<b>0.7411</b>	<b>33.3894</b>
Observations	1235				1235				1235			
R <sup>2</sup>	0.0160				0.0178				0.0231			
DW	1.9221				2.1881				2.2449			
	RABBV				RBMV				RPFE			
	Mean Equation		Variance Equation		Mean Equation		Variance Equation		Mean Equation		Variance Equation	
	coefficient	z-stats	coefficient	z-stats	coefficient	z-stats	coefficient	z-stats	coefficient	z-stats	coefficient	z-stats
C	0.0005	1.2866			0.0028	7.2701			0.0000	0.1962		
RGILD					0.2041	16.8851			0.0490	3.4316	-3.7563	-2.4818
RABBV									0.1557	16.4996	3.9763	3.8843
RCHINEXT					0.0721	4.8970	2.4410	4.5589				
RDVAX	0.0136	2.3627	-0.9916	-2.4221								
RBMV	0.3871	23.4960	-12.7331	-14.4177			-17.9676	-29.1097	0.2466	20.9511	-7.0298	-5.7251
RPFE	0.4147	13.6764	1.9380	2.4671	0.4256	16.7840	4.7112	3.5582				
COV19											0.1590	2.2555
$\alpha_0$			-1.6089	-10.9871			-0.9208	-10.8398			-2.2217	-8.3934
$\alpha_1$			<b>0.0093</b>	<b>0.4590</b>			<b>0.1820</b>	<b>10.3454</b>			<b>-0.0859</b>	<b>-3.2006</b>
$\lambda_1$			0.4716	14.2694			-0.0817	-4.6271			0.4981	11.6877
$\beta_1$			<b>0.8472</b>	<b>50.1501</b>			<b>0.8868</b>	<b>85.7061</b>			<b>0.8040</b>	<b>30.8188</b>
Observations	1235				1235				1235			
R <sup>2</sup>	0.2824				0.2359				0.3137			
DW	1.9797				1.9753				2.1119			

Dynavax stocks experienced a fall in contrast with the major stock indices in the global financial markets just after the announcement of the outbreak. However, the biopharmaceutical company's stocks rebounded very quickly since Dynavax, as a commercial-stage vaccine company, which is providing CpG 1018, the adjuvant contained in U.S. FDA-approved HEPLISAV-B vaccine, to support the rapid development of Clover's COVID-19 vaccine, can play a vital role in the fight against this pandemic.

For the variance equation, the COVID-19 dummy variable is valid and significant at %1 level for Chinext, Gilead<sup>7</sup>, Dynamax, and Pfizer and has volatility increasing impact. Considering its unique contribution to the hassle with COVID-19,  $\alpha_1$  in RDVAX model is one of the highest levels observed among all other models which refers that short-term shock has a more significant impact on Dynavax stock returns. The level of  $\alpha_1$  is also high in RBMY model compared to other models Bristol-Myers Squibb's stock has declined due to the Coronavirus/Oil Price War crisis however, it could bounce back strongly as the crisis winds down. COVID-19 dummy is not significant in both mean and variance equation in the RBMY model so we can conclude that short term shocks for Bristol-Myers is due to the major market indices trend, not a specific reaction to pandemic itself but a reaction the overall falling trend of financial markets. The sum of the coefficients of the lagged squared error and the lagged conditional variance are close to unity (0.99) for Chinext, Gilead, Dynamax, and Bristol-Myers Squibb, implying that shocks to conditional variance are highly persistent. For Pfizer and Abbvie the impact of persistency is lower compared to Chinext, Gilead, Dynamax, and Bristol-Myers Squibb.

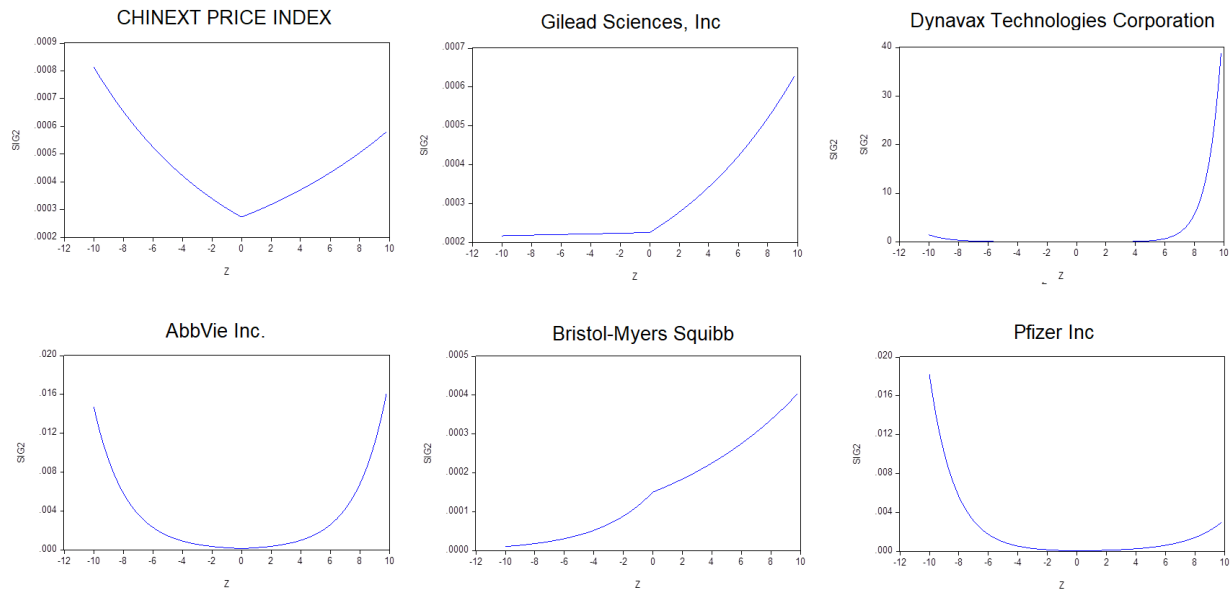
**Figure 3: Chinext and Dynavax Price Graph after Covid-19 Outbreak**



Hence EGARCH models are important for us to obtain News Impact Curves (NICs) and test the leverage effect (Figure 5). Any news increases volatility however if the news is “good” volatility increases along the right side of the curve. If the news is “bad” volatility increases along the left side of the curve.

<sup>7</sup> Gilead has been working in consultation with regulatory authorities to establish additional expanded access programs for remdesivir, our investigational medicine for COVID-19. The programs enable hospitals or physicians to apply for emergency use of remdesivir for multiple severely ill patients at a time.

Figure 4: News Impact Curves



Since Gilead and Dynavax's right side of the NICs is steeper than the left side, a positive  $\varepsilon_t$  shock will have a bigger effect on volatility than a negative shock of the same magnitude. For Abbvie the NIC is nearly symmetric which suggests that any news good or bad has the same impact on the volatility of returns. Finally, Chinext and Pfizer since the left side of the curve are steeper than the right side, a negative  $\varepsilon_t$  shock will have a bigger effect on volatility than a positive shock of the same magnitude which is quite consistent with an approach that Chinext and one of the major players of the pharma industry, which is not specifically related with the fight against this pandemic, represents a more general market. In this context, we can also conclude that companies like Gilead and Dynavax which have more to the point roles in the outbreak period compared to other global pharmaceutical companies react to good news more intensely. Gilead is a longtime drugmaker best known for developing the first major cure for hepatitis-C in Sovaldi while Dynavax's adjuvant technology can help provide an increased immune response to a vaccine that makes them usual suspected solution providers for the pandemic.

## 6. CONCLUSION

Financial markets in the time of the coronavirus pandemic hard to predict due to the noise in the markets. Dow Jones Industrial dropped nearly 1,200 points marking the worst intraday point decline in the history of the Dow. The reason for this collapse was a growing consensus that COVID-19 has landed on U.S. shores and will likely have a stronger impact on the economy than the investors initially predicted. COVID-19 is a once-in-a-lifetime business opportunity for most of the pharmaceutical and biotech companies. However, due to the news impact curves, we claim that the impact of COVID-19 is not a de facto for all related industry companies. There are outstanding companies such as Gilead with its remdesivir which was originally developed to treat the Ebola virus and Dynavax partnering with vaccine developer companies to use its technology. The asymmetry in the NICs for the favor of good news suggests that companies like Gilead and Dynavax are priced by the market with an expectation to find the cure or play an important part in this process. Companies like Gilead and Dynavax which have more to the point roles in the outbreak period compared to other global pharmaceutical companies react to good news more intensely. Finally, this paper is a preliminary study for upcoming research papers after the impact of COVID-19 on financial markets, pharmaceuticals and biotechnology companies becomes more visible.

## REFERENCES

- Cappiello, L., Engle, Sheppard, K., (2006), Asymmetric Dynamics in the Correlations of Global Equity and Bond Returns, *Journal of Financial Econometrics*, Vol. 4, No. 4, pp. 537–572
- Chen, C. D., Chen, C. C., Tang, W. W., and Huang, B. Y. (2009). The positive and negative impacts of the SARS outbreak: A case of the Taiwan industries. *The Journal of Developing Areas*, 281-293.
- Chen, X., Ghysels, E., (2010), News-Good or Bad-and Its Impact on Volatility Predictions over Multiple Horizons, *The Society for Financial Studies*, Oxford University Press.
- Chen, M. P., Lee, C. C., Lin, Y. H., & Chen, W. Y. (2018). Did the SARS epidemic weaken the integration of Asian stock markets? Evidence from smooth time-varying cointegration analysis. *Economic research-Ekonomska istraživanja*, 31(1), 908-926.
- Chen, M. H., Jang, S. S., and Kim, W. G. (2007). The impact of the SARS outbreak on Taiwanese hotel stock performance: an event-study approach. *International Journal of Hospitality Management*, 26(1), 200-212.
- Donadelli, M., Kizys, R., & Riedel, M. Globally (2015). Dangerous Diseases, Sentiment and Pharmaceutical Stock Prices. <http://sfm.finance.nsysu.edu.tw/php/Papers/CompletePaper/038-1674094255.pdf>
- Donadelli, M., Kizys, R., & Riedel, M. (2017). Dangerous infectious diseases: Bad news for Main Street, good news for Wall Street?. *Journal of Financial Markets*, 35, 84-103.
- Keogh-Brown, M. R., Smith, R. D., Edmunds, J. W., and Beutels, P. (2010). The macroeconomic impact of pandemic influenza: estimates from models of the United Kingdom, France, Belgium and The Netherlands. *The European Journal of Health Economics*, 11(6), 543-554.
- McKibbin, W. J., and Fernando, R. (2020). The global macroeconomic impacts of COVID-19: Seven scenarios
- Morales, L., and Andreosso-O'Callaghan, B. (2020). Covid19: Global Stock Markets "Black Swan". *Critical Letters in Economics & Finance*, 1(1), 1
- Nelson, B., D. (1991), Conditional Heteroskedasticity in Asset Returns: A New Approach, *Econometrica*, Vol. 59, No. 2., pp. 347-370
- Nippani, S., & Washer, K. M. (2004). SARS: a non-event for affected countries' stock markets?. *Applied Financial Economics*, 14(15), 1105-1110.
- Sherman IW. Dünyamızı Değiştiren On İki Hastalık. (Çev:Emel Tümbay, Mine Arığ Küçüker). *Türkiye İş Bankası Yayınları*. İstanbul, 2016.
- Solarin, S. A. (2015). September 11 attacks, H1N1 influenza, global financial crisis and tourist arrivals in Sarawak. *Anatolia*, 26(2), 298-300.
- Tiryaki, H.N., Ekinci, A., (2015). "Finansal bulaşıcılık çerçevesinde küresel kriz ve Türkiye'ye etkileri", *Sakarya İktisat Dergisi*, Cilt.4, Sayı:1, 1-30
- Verikios, G., McCaw, J. M., McVernon, J., and Harris, A. H. (2012). H1N1 influenza and the Australian macroeconomy. *Journal of the Asia Pacific Economy*, 17(1), 22-51.
- Wang, Y. H., Yang, F. J., and Chen, L. J. (2013). An investor's perspective on infectious diseases and their influence on market behavior. *Journal of Business Economics and Management*, 14(sup1), S112-S127.
- Worldometers, URL: <https://www.worldometers.info/coronavirus> (2020)
- Zeren, F., and Hızarcı, A. The Impact Of Covid-19 Coronavirus On Stock Markets: Evidence From Selected Countries. *Muhasebe ve Finans İncelemeleri Dergisi*, 3(1), 78-84.