International Capital Flows and Dynamic Changes in Pfizer Stock Prices: A Long-term Perspective

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Abstract. The stock and exchange rate markets play central roles in domestic and international trade. Since volatility of either one of them can bring significant impact to any business. It is essential to find how changes in exchange rate influence the stock market so that policymakers can build appropriate regulations to boost the national stock market, and investors may invest by taking the minimum risk. This paper selects the stock of a well-known multinational firm, Pfizer, and the US dollar index from October 27, 2005, to September 5, 2019. It applies the ADF test to validate the stationarity of the sample data, the VAR model with IRF to investigate whether the increasing exchange rate brings a positive effect on Pfizer's stock return or not, and the ARMA-GARCHX model to study whether the volatility of exchange rate is significant to changes of Pfizer's stock return in the long run. The study's findings indicate that the exchange rate volatility does not have a long-term relationship with Pfizer's stock price.

Keywords: US dollar index, Pfizer, Multinationals, VAR, ARMA-GARCHX.

1. Introduction

Starting on August 15, 1971, the gold standard was abandoned in the United States. Even if there is no world currency anymore, the world's dominant reserve currency has been the U.S dollar. More than 60% of the central bank currency reserves use the dollar, and various commodities take the dollar to set their prices [1]. In this case, the U.S. dollar index (USDX) fluctuation greatly influences the global economy, including the stock market, imports, exports, commodity prices, and currency pairs. Since the U.S dollar index is a measure of the value compared to six other currencies: Euro (EUR), Japanese Yen (JPY), British Pound (GBP), Canadian Dollar (CAD), Swedish Krona (SEK), and Swiss Franc (CHF), the rise and fall of the U.S. dollar index primarily affect earnings of multinational corporations when converted to the dollar [2].

A strong dollar brings profits for importers but negatively impacts others. As the dollar index increases, companies and transactions happening in the U.S. benefit from imports because the cost of goods is paid in strong dollar with lower price as goods are manufactured and sold on a devalued currency [3]. Nevertheless, overseas branches of an American multinational firm get reduced revenue, given that its major revenue and financial statements are calculated in the U.S. dollar. Hence, money gains or loses more depending on the location of transactions and the type of operations. It is hard to decide whether they offset, or one outperforms the other by casual observation.

Meanwhile, a strong dollar also renders variation in the stock market. A tendency is that an increase in the U.S. dollar index will coincide with rising indices of the U.S. stock market, which is a positive correlation. This is because U.S. stocks are denominated in dollars, and foreign investor need to first buy U.S. dollar before placing their money into stock market, causing a higher demand for dollars than other currencies. Such a situation leads to an increase in the dollar index. While the inverse situation causes more investors to convert money into dollars to put them into the U.S. market, which drives up stock prices.

Pfizer Inc. is an American multinational pharmaceutical and biotechnological corporation headquartered on 42nd Street in Manhattan, New York City, and has branches or manufacturing sites in 51 countries [4]. It is one of the components of the S&P 100 and ranked 64th on the Fortune 500 and 49th on the Forbes Global 2000. Its stock trades on the New York Stock Exchange (NYSE) with code PFE. This corporation suffers and benefits from the rise of the dollar index. Without further

investigation, it is cursory to tell if the fluctuation of the dollar index will bring a more severe or beneficial impact on the stock price of the firm.

While some effect from the volatility of the dollar index will be shown in the stock price of Pfizer Inc, this may not be unsustainable. According to the related data and existing literature, this paper expects that the fluctuation of the dollar index will not cause a long-term change in Pfizer Inc.'s stock price, although some trends are visible in the short term.

The rest of the paper will be divided as follows: Part 2 is a literature review, which lists related papers on the relationship between exchange rate and multinational firms and the relationship between exchange rate and stock market. Then Part 3 will display the models' design by stating the dataset's origin, implementing the augmented Dickey-Fuller test, and setting the vector autoregressive (VAR) model and the ARIMA-GARCHX model. After that, the fourth section will illustrate empirical analysis and result of the order of the VAR model, impulse response function, the order of autoregressive moving average (ARMA) model, and ARMA-GARCHX mode. It is followed by Part 5, which compare the result of Part 3 with related literature, implications from the result, and how investor and policy maker should utilize this paper. Finally, Part 6 summarizes the paper's findings and feasible suggestions for future research in the stock of Pfizer Inc.

2. Literature Review

The dollar index for multinational companies represents volatile uncertainty. Based on Jorion's study, the relationship between the value of US multinational firms and the exchange rate has significant cross-sectional differences [5]. The sensitivity of the firm's value was positively related to the degree of foreign involvement. Bartram and Bodnar suggest that 10%-25% of all firms studied from the US indicate significant exchange rate exposures [6]. This proportion is below expectation from prior theoretical and anecdotal predictions. They also point out that non-financial firms could reduce the long-term influence of exchange rate changes on firm value by executing risk management through financial hedging and operational hedging. Such exposure implementation would make firms have no exposure at the beginning or reduce it to the undetectable level. Also, a multinational corporation may differ in its operation based not several factors, not only the exchange rate [7]. To illustrate, Itagaki finds that the impact of exchange risk, international taxation, and forecast of depreciation from home currency and other factors depends on earning of a multinational firm in the foreign currency being positive or negative, the firm's repatriation policy of foreign profits, and the foreign operational branches or subsidiaries. Bergbrant, Campbell, and Hunter investigate a sample of about 2400 firms from 55 countries, which supports the proposition that exchange rate exposure is higher for those corporations involved in foreign trade than those that do not [8]. Besides, the evidence also reflects that import-only and export-and-import firms have higher greater exposure than domestic other than export-only firms. By observing a sample of the 32 corporations from Fortune magazine's "50 Leading Exporters" list from 1982–1988, Amihud examines the hypothesis that the value of US exporting firms has a negative relation to fluctuations in exchange rates of the foreign dollar against the US dollar with the result that volatility of exchange rate does not affect the values of exporting companies [9]. In the study by Choi and Prasad, 60% of the firms from a sample of 409 US multinational firms during 1978-1989 benefited from significant currency rate exposure as the dollar devalued [10]. Also, the cross-sectional variation in firms' exchange rate sensitivity is related to specific operational factors.

In the global economy, the correlation between stock price and currency rate is mostly weak in the long run. Ajayi and Mougoue use the error correction model (ECM) on stock price and exchange rate for a sample of 8 advanced economies with the result that currency depreciation harms the stock market in the short and long run [11]. There also exists a reverse relationship between these two variables, but this is not in the scope of focus in this paper. Bernard and Galati explore the relationship between the US dollar and stock markets between 1983 and 2000 and conclude that the US stock market and currency rate do not have a robust significant correlation [12]. Also, there exists historical

data showing ascending relation between these two factors. Nevertheless, the nature of the relationship changes over time. Therefore, factors other than the US stock market and its currency rate had a volatile influence on the co-movement of the US stock market and the dollar. Oskooee and Sohrabian discover a bidirectional relationship between exchange rates and stock prices measured by S&P 500 in the short run [13]. The long-run relationship between two variables does not reveal by using the cointegration analysis. Ajayi, Friedman, and Mehadian investigate casual relations between stock returns and changes in currency rates by using the Granger causality test for a set of developed and emerging markets [14]. A unidirectional relationship exists between the stocks and currency rates in developed countries, while no consistent relationships are found in developing countries. The overall result indicates that the stock and currency markets are well integrated into the developed countries where the exchange rates respond to innovations in the stock markets. Granger, Huang, and Yang discuss if currency depreciation leads to smaller stock prices or vice versa based on the Asian Crisis of 1977 [15]. They conclude that stock prices do not react uniformly to exchange rates since data from some countries reinforces the bivariate causality. Currency depreciation could positively or negatively affect a firm's value, and such a variable depends on the major operations between import and export.

To summarize, the research on the correlation between the dollar and multinational firms, dollar and stock market were explored to some extent. However, there is a small gap in the long turn effect of the volatility of currency rate leading to the dynamic changes of a multinational biotechnological firm, and the relevant search from the related topic was mainly before 2000. Therefore, this paper hopes to discover the more recent impact of the dollar index on the stock price of a multinational firm by using empirical data analysis and advanced models.

3. Research Design

3.1 Data Source

The data consists of closing stock prices of Pfizer Inc and US dollar indices on daily basis for the period from October 27, 2005 to September 5, 2019. The former is collected from the Choice financial terminal, a search engine, and the latter is obtained from investing.com, a financial platform and news website [16, 17]. The period is chosen before spreading of COVID-19 in order to eliminate profound impact of the pandemic to currency rates and US stock market.

3.2 ADF Test

To check the interaction between stock price and currency rate, it is essential to first determine whether the sample data is stationary or not. Augmented Dickey Fuller (ADF) test is applied to check the stationarity/unit roots of data. Since it is a statistical significance test, there is a hypothesis testing with a null and alternative hypothesis, and whether rejecting the null hypothesis depends on calculated test statistics and corresponding p-values. Given that the null hypothesis is the time series being nonstationary with $\beta = 1$, ADF test employs the following equation:

$$x_t = c_t + \beta x_{t-1} + \sum_{i=1}^{p-1} \phi_i \Delta x_{t-i} + e_t \quad (1)$$

where x_t is the series being tested, p-1 is the number of lagged differences for capturing autocorrelation such that Ljung-Box Q-statistics fails to reject the null hypothesis of no correlation within the series from the residual of the above equation. After putting the data into Stata and performing ADF test, we obtain result as shown in Table 1 that the p-value for log-return is 0, which is smaller than 0.1. Hence, the test allows to reject the null hypothesis, which indicates that the log-return series does not have unit root.

Table 1 ADF test

Variables	t-statistic	p-value
Price		
Pfizer	-2.064	0.5664
USD index	-1.241	0.9017
Yield		
Pfizer	-44.507	0.0000***
USD index	-41.340	0.0000***

3.3 VAR Model

After confirming log-return time series being stationary, this paper hopes to affirm whether there exists a bidirectional relationship between log-return of US exchange rates and Pfizer stock prices. Hence, VAR model is introduced to validate such relationship, which treats all variables symmetrically and models them as though they influence each other in the same degree. In the VAR model, each variable is modeled as a linear combination of lags of all the variables from itself and other variables in the system with a constant term. Since the sample data in this paper comprises two variables, a bivariate system of equations is the following:

$$y_{1t} = \beta_{10} + \beta_{11}y_{1,t-1} + \cdots + \beta_{1p}y_{1,t-p} + \gamma_{11}y_{2,t-1} + \cdots + \gamma_{1p}y_{2,t-p} + \varepsilon_{1t} \quad (2)$$

$$y_{2t} = \beta_{20} + \beta_{21}y_{2,t-1} + \cdots + \beta_{2p}y_{1,t-p} + \gamma_{21}y_{2,t-1} + \cdots + \gamma_{2p}y_{2,t-p} + \varepsilon_{2t} \quad (3)$$

where $\varepsilon_{1t}, \varepsilon_{2t}$ are white noises process that may be contemporaneous correlated, meaning that they contain the relation:

$$Cov(\varepsilon_{1t}, \varepsilon_{2t}) \begin{cases} \sigma_{12}, & if\ t = s \\ 0, & otherwise \end{cases} \quad (4)$$

In the process of constructing VAR model, the number of lags needs to be determined first. There are several information criterions can be applied: the likelihood ratio (LR) test, Akaike Information Criterion (AIC) and Schwarz Criterion (SC).

LR test defines as the following:

$$LR = -2(LogL_k + LogL_{k+1}) \quad (5)$$

where L_k stands for likelihood function evaluate at the MLE with k endogenous variables. The null hypothesis is generated by a VAR with p_0 lags against alternative hypothesis with $p_1 > p_0$. Under null hypothesis, LR asymptotically has a chi-square distribution with N^2 degrees of freedom, where N denotes the number of variables in the system of VAR model. When error terms conform to the assumption that they are multivariate normal distributed, then it is plausible to use LR test to estimate parameters of VAR model. Such test not only overcomes contemporaneous correlation, but also have no impact on explanation of actual meaning of variables. Granted that this information criterion requires error terms satisfying the assumption of multivariate normal distribution, this constraint can be ignored in the most of sample data.

AIC and SC determine the most suitable lag number p when their statistics are at minimum. The equations that calculate their statistics are shown below:

$$min_k\{AIC\} = log\left[\frac{\sum_{t=1}^{T} e_{kt}^2}{\sum_{t=1}^{T} e_{(k+1)t}^2}\right] - \frac{2}{T} \quad (6)$$

$$min_k\{SC\} = log\left[\frac{\sum_{t=1}^{T} e_{kt}^2}{\sum_{t=1}^{T} e_{(k+1)t}^2}\right] - \frac{logT}{T} \tag{7}$$

After that, impulse response function (IRF) is introduced in this paper, which employs on VAR model. The main purpose is to describe the evolution of log-return from Pfizer Inc. stock price in reaction to a shock in log-return of US dollar currency. The function is written in the following form:

$$\frac{\partial y_{i,t+s}}{\partial \varepsilon_{jt}} = \psi_s \tag{8}$$

It represents when the disturbance term ε_{jt} of j variable at time t increments by one unit, the degree of influence imposes to the value of $y_{i,t+s}$. This paper will discuss whether a shock of log-return of US dollar indices will influence the log-return of stock price for Pfizer Inc. in the long term. If impact of the shock to VAR model declines and vanishes as the time moves, then VAR model is stable.

The necessary and sufficient condition for stability of VAR model is determined by using the equation:

$$X_t = \sum_{i=1}^{p} \Pi_i X_{t-i} + U_t \tag{9}$$

which means that all eigenvalues of the coefficient matrix have to lie inside unit circle. Such condition for ensuring stability is identical to that of AR model.

3.4 ARMA-GARCHX model

3.4.1 Model Specification: ARMA

The full ARIMA model can be written as:

$$x_t = \emptyset_0 + \sum_{i=1}^{p} \emptyset_i x_{t-i} + \alpha_i + \sum_{i=1}^{q} \emptyset_i \alpha_{t-i} \tag{10}$$

The above equation is a linear combination of AR(p) and MA(q). The AR(p) is $\emptyset_0 + \sum_{i=1}^{p} \emptyset_i x_t - i$, which uses historical log-return of Pfizer Inc.'s stock to forecast future, and the MA(q) consists of $\alpha_i + \sum_{i=1}^{q} \emptyset_i \alpha_t - i$, using historical forecast errors to estimate future.

3.4.2 Model Specification: ARIMA-GARCHX

This paper constructs ARIMA-GARCHX model of the log-return of stock price from Pfizer Inc. with log-return of US dollar indices as one additional exogeneous explanatory variable adding to the model. Consequently, this paper can analyze the correlation between log-return and volatilities of stock price from Pfizer Inc. and fluctuation of US exchange currency.

The GARCH (p, q) defines as the following:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \cdots + \alpha_q \varepsilon_{t-q}^2 + \gamma_1 \sigma_{t-1}^2 + \cdots + \gamma_p \sigma_{t-p}^2 + \beta Exchange\ rate_t \tag{11}$$

According to the above equation, $\alpha_1 \varepsilon_{t-1}^2 + \cdots + \alpha_q \varepsilon_{t-q}^2$ belongs to ARCH(p) model and, $\gamma_1 \sigma_{t-1}^2 + \cdots + \gamma_p \sigma_{t-p}^2$ is the autoregression term of σ_t^2. It is worth to mention that σ_t^2 is the conditional variance of disturbance terms $\varepsilon_{t-1}, \ldots$, and subscript t indicates that σ_t^2 is mutable as

time moves. Furthermore, the last term in the above equation $Exchange\ rate_t$ illustrates the influence of adding the exchange rate into the model at each corresponding period.

The major property of GARCH model is to reduce the number of estimated parameters, so that the forecast accuracy of future σ_t^2 will have less error. Besides, ARCH(p) can be simplified as GARCH (1, 1) for high order of p.

4. Empirical Result

4.1 Lag Value of VAR model

By using Stata, we gain values from different information criterions for variables log-return of stock index from Pfizer Inc. and log return of US dollar indices under VAR (2) model as shown below.

Table 2 VAR model identification

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	22724.7				5.8e-09	-13.2881	-13.2868*	-13.2845*
1	22729	8.5822	4	0.072	5.8e-09	-13.2883	-13.2844	-13.2775
2	22733.7	9.57	4	0.048	5.8e-09	-13.2887	-13.2823	-13.2708
3	22736.2	4.9131	4	0.296	5.8e-09	-13.2878	-13.2789	-13.2627
4	22744.2	15.991	4	0.003	5.8e-09	-13.2902	-13.2786	-13.2579
5	22749.9	11.338	4	0.023	5.8e-09	-13.2911	-13.277	-13.2517
6	22750.6	1.3749	4	0.849	5.8e-09	-13.2892	-13.2725	-13.2426
7	22754.3	7.5267	4	0.111	5.8e-09	-13.2891	-13.2698	-13.2352
8	22757.8	7.0193	4	0.135	5.8e-09	-13.2888	-13.267	-13.2278
9	22764.5	13.442	4	0.009	5.8e-09	-13.2904	-13.266	-13.2222
10	22768.4	7.7661	4	0.101	5.8e-09	-13.2903	-13.2634	-13.2149
11	22773.8	10.816	4	0.029	5.8e-09	-13.2911	-13.2616	-13.2086
12	22776.4	5.0477	4	0.282	5.8e-09	-13.2903	-13.2582	-13.2005
13	22779.6	6.4473	4	0.168	5.8e-09	-13.2898	-13.2552	-13.1929
14	22784	8.9131	4	0.063	5.8e-09	-13.2901	-13.2529	-13.186
15	22789.5	10.825	4	0.029	5.8e-09	-13.2909	-13.2512	-13.1796
16	22795.5	12.088	4	0.017	5.8e-09*	-13.2921*	-13.2498	-13.1737
17	22796.7	2.4851	4	0.647	5.8e-09	-13.2905	-13.2456	-13.1649
18	22800.4	7.3884	4	0.117	5.8e-09	-13.2903	-13.2429	-13.1575
19	22802.8	4.8229	4	0.306	5.8e-09	-13.2894	-13.2394	-13.1494
20	22804.7	3.7662	4	0.439	5.8e-09	-13.2881	-13.2356	-13.141
21	22809.6	9.7204*	4	0.045	5.8e-09	-13.2886	-13.2335	-13.1343
22	22812.6	5.9894	4	0.200	5.8e-09	-13.2881	-13.2304	-13.1265
23	22814.5	3.8363	4	0.429	5.8e-09	-13.2868	-13.2266	-13.1182
24	22817	5.0145	4	0.286	5.8e-09	-13.286	-13.2231	-13.1101

Through Table 2, the most proper lag value p for VAR model is 21 based on LR test. After setting the lag parameter, the VAR (21) estimation of log-return of Pfizer Inc. stock price and US exchange indices need to be verified whether all the eigenvalues of the coefficient matrix are lying within the unit circle, i.e., the model is stationary. From Figure 1, the stability of estimated model is confirmed.

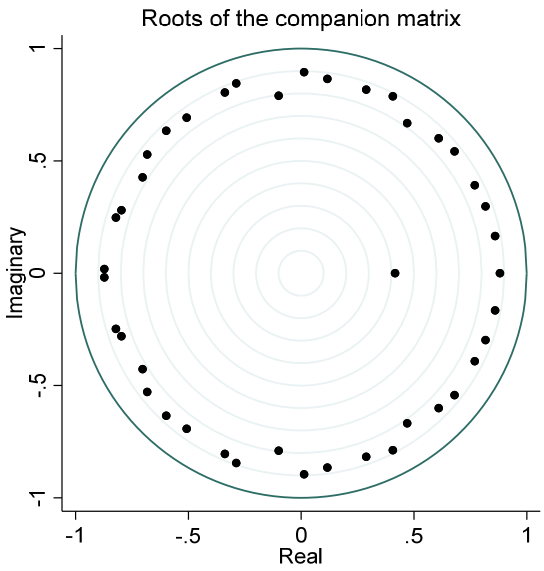

Figure 1 VAR stability

4.2 Impulse Response Analysis

Theoretically, rise of US dollar indices would result in high demand of the dollar in foreign capital and international financial market, which would further enhance the demand of dollar. In this case, Pfizer Inc. will face two kinds of consequences. One is that Pfizer Inc., as a multinational corporation using US dollar as currency unit, records profits, and loss on their balance sheets. Appreciation of US exchange rate will devalue the firm's foreign operations, which will be reflected on their balance sheet as loss. Once the loss is announced, the firm's stock price will drop. Besides, such appreciation also boosts an increase in domestic wealth, which gives rise to increase in demand of US dollar. an increase in interest rates. High interest rate will restrain indigenous consumption, which is another factor that results in decrease of stock price.

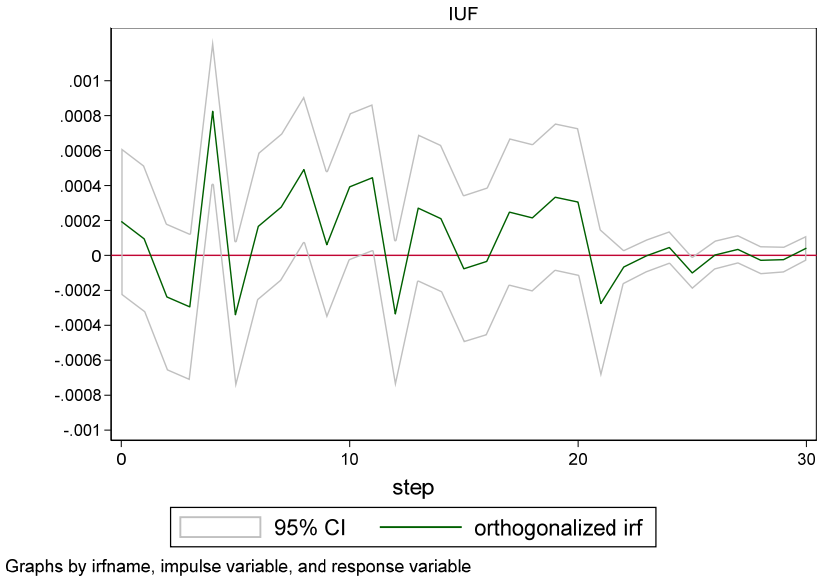

Figure 2 Impulse and response

On the other hand, foreign investors have large wealth in US dollar, so their fund will flow to either security market or bond market, resulting in high demand of stocks and appreciation of stock prices.

Based on the estimation of IRF from its equation, one unit of shock from log-return of US dollar index to the log-return of Pfizer Inc.'s stock price brings positive effect at t = 0. Specifically, the largest positive effect is located at t = 4 with value 8%, immediately following the most negative effect with value -3%. As time moves, impulse creating from log-return of US dollar index decreases, starting from t = 25. In order to avoid misjudgment, Figure 3 illustrates the cumulative impulse response function with in total 30 periods, which justify observations from Figure 2 since cumulative response of log-return of US dollar indices is positive, and the aggregate effect of impulse is approximately 1.5%.

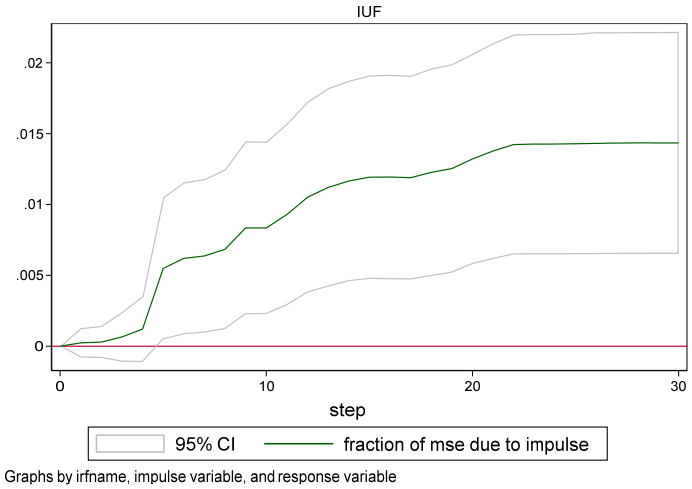

Figure 3 Cumulative response

As a result, this paper discovers shock from log-return of US exchange indices having positive impact to the log-return of Pfizer Inc.'s stock price, which indicates that capital inflow from international capital and foreign investor preponderates over devaluation of the firm's overseas operations.

4.3 Order Selection of ARMA Model

Before fitting the ARMA, it is essential to order the first log-return series using ACF and PACF pairs, the results of which are shown in Figure 4.

From the fixed order result of the two images in Figure 4, there are 7 lag values beyond the x-axis: 1, 2, 5, 9, 10, 15 and 16. Hence, AR(p) has the order of (1, 2, 5, 9, 10, 15, 16), while MA(q) also follows the same sequence, i.e. the values of p and q are both (1, 2, 5, 9, 10, 15, 16).

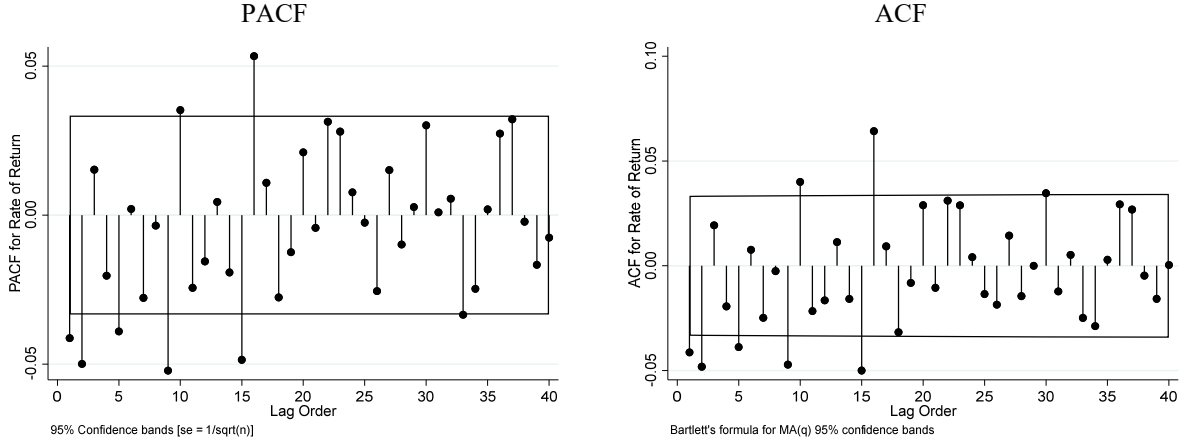

Figure 4 PACF and ACF

4.4 ARMA-GARCHX

To have better accuracy on forecasting volatility of future log return of Pfizer Inc.'s stock price, this paper uses ARCH model for testing the characteristics of the firm's log-return volatility. According to the plot in Figure 5, there exists a clear conditional heteroskedasticity in the firm's stock indices. Such phenomenon can be explained by return fluctuating sharply in one period while being stable in the other. Theoretically, when the volatility (variance) of is greater in the current period or several past periods, the future volatility (variance) is possible to be large, and vice versa. This can be described as volatility clustering. However, whether there is autoregressive conditional heteroskedasticity and how significant the conditional heteroskedasticity is still needed to be considered by the result from model estimation.

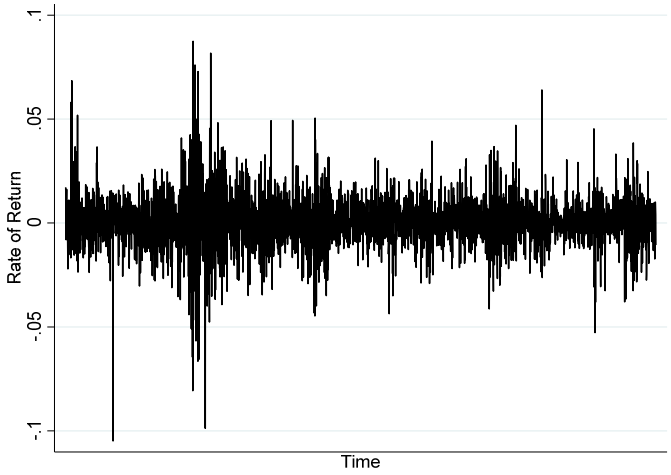

Figure 5 Yield trend

After estimating the model, the detail of estimating ARIMA-GARCHX model can be found in Table 3. From the estimation result of first variance equation, both the ARMA term and GARCH term of the model are significant, thereby there is significant conditional heteroskedasticity in the Pfizer Inc's stock index log-return and such conditional heteroskedasticity indicates that the variance of returns is aggregated and can be used for GARCH modelling. Furthermore, the estimated result of external explanatory variable shows that the coefficient of log-return from US dollar indices is insignificant, demonstrating that the volatility of log-return in US dollar index does not influence the volatility of log-return in Pfizer Inc's stock price in the long term.

Table 3 ARMA-GARCHX estimation results

	Coefficient	Std. err	z	P>|z|
Mean equation				
AR, L1	.1897	.0941	2.02	0.044
AR, L2	-.0964	.0501	-1.92	0.054
AR, L5	.3736	.0723	5.16	0.000
AR, L9	.0473	.0794	0.60	0.551
AR, L10	.4873	.0960	5.08	0.000
AR, L15	-.4457	.0856	-5.20	0.000
AR, L16	-.3084	.0366	-8.43	0.000
MA, L1	-.2019	.0930	-2.17	0.030
MA, L2	.0879	.0479	1.84	0.066
MA, L5	-.3812	.0686	-5.55	0.000
MA, L9	-.0814	.0781	-1.04	0.298
MA, L10	-.4534	.0981	-4.62	0.000
MA, L15	.4210	.0841	5.00	0.000
MA, L16	.3441	.0344	9.98	0.000
Constant	.0004	.0001	2.79	0.005
Variance equation				
Exchange rate	33.4363	33.6969	0.99	0.321

ARCH, L1	.0982	.0086	11.36	0.000
GARCH, L1	.8780	.0093	93.86	0.000
Constant	-12.4199	.1284	-96.68	0.000

5. Discussion

The major purpose of this study is to discover the impact of volatility in US dollar indices on the dynamic change of Pfizer Inc. stock price in the long term and to forecast and make recommendations on the future direction of investment and policy making. In the context of the increase in the US exchange rate, this article concludes that Pfizer Inc.'s stock price will be positively affected by the rise in the US exchange rise, while this impact is not significant enough to have a long-term influence on the firm's capital inflow and price in the stock market.

This result is supported by propositions in the past literature, as they all stated the weak relationship between stock price and exchange rate in the long term. One difference is that those related works tend to uncover a bidirectional relationship between two variables, whereas this paper explores one side.

As a result, some propositions can be made. Firstly, if the US appreciates the exchange rate to raise domestic stock prices, such a policy will not be powerful. Secondly, a US multinational corporation interested in forecasting its stock price in the long term should not use the volatility of the home country's currency rate as an effective indicator. Finally, another implication worth noticing is the effect of shock from the currency unit that records the profit or loss of a multinational firm in the balance sheets to the stock market. Such impact may be positive, i.e., the capital inflow from the international financial market to the stock market outdoes the loss from oversea branches or subsidiaries. However, this relationship is ambiguous, which means that the real situation may depend on foreign involvement or operations in oversea countries.

This paper may provide implications for different readers. For policymakers, it is ineffective to use the volatility of the US dollar index to boost the domestic stock market, especially stocks of multinational companies. Concerning investors, consideration of factors or data other than currency rate is a more advisable choice to forecast the long-term trend of stock in the US.

6. Conclusion

This paper investigates the long-term relationship between the US exchange market and Pfizer Inc.'s stock price by taking data from October 27, 2005, to September 05, 2019. ADF test indicates the exchange rate and stock prices. Then, IRF is used to observe if one unit of shock from US dollar indices will result in the sample being stationary but are first-difference stationery with logarithm. In addition, the estimated result from IRF to the fitted VAR model shows that an increase in the US dollar index will positively affect Pfizer Inc.'s stock price, which exceeds the loss from the depreciation of revenue in overseas branches. Eventually, the ARMA-GARCHX model is fitted and concludes that volatility of the US dollar index does not affect Pfizer Inc.'s stock price in the long term, even if it brings benefits at the start, which exceeds the loss from operations in the foreign branches. Thus, the long-term forecasting of trends in Pfizer Inc.'s stock price may not use the US exchange rate as an effective indicator, which implies that future studies may consider other possible factors that can be helpful in predicting Pfizer Inc.'s stock price in the long run.

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