

Dynamic Changes in Disney Stock Price under Normalized Covid-19 Pandemic

Yaxin Zhang

Department of Mathematics, University of Manchester, Wuhan, M13 9PL, China

yaxin.zhang-3@student.manchester.ac.uk

Abstract. Since the COVID-19 pandemic explosion in January 2020, the progress of numerous companies has been affected and, naturally, stocks have seen a correction as a result. In this article, the overall impact of the COVID-19 pandemic will be analyzed under assessing the impact on Disney stock. In order to analyze the change in variation between the COVID-19 pandemic and the fluctuation in the price of Disney stock, the initial intercept was between the closing price of Disney stock and the total number of new infections recorded at the beginning of the COVID-19 pandemic breakout. These data were used to calculate the daily number of new infections and the return on Disney stock. The data were first tested for stationarity using the ADF Test and then a VAR model and an ARMA-GARCH model were developed for these data. This study showed that the effect of COVID-19 on Disney stock was not significant. At the end of the article, two types of investor psychology are analyzed and some references are given to investors.

Keywords: COVID-19; Disney; Stock Volatility.

1. Introduction

COVID-19, which began in Wuhan, China, as created by the SARS-CoV-2 virus, has since swept the world. The virus is extremely transmissible and far more frightening than people could have imagined, and the subsequent dramatic rise in the number of infections and deaths has had a strong impact on people's lives. As of 29 July 2022, the cumulative number of new infections worldwide has reached approximately 570 million. This has led to a dramatic change in the way people live their lives, forcing them to work and study online and not travel, leading to a series of service industries being affected. Interest rates are at record lows, there are spillover effects throughout supply chains, and COVID-19 is a genuinely global pandemic [1]. The outcome is, the COVID-19 pandemic's effects are more severe than those of other pandemics like the Spanish Flu in 1918 and the Ebola pandemic in 2014 [2]. The COVID-19 outbreak has caused a great deal of volatility in the economy and its numerous sectors, which might result in unexpectedly significant changes. Stocks, which are after all intimately connected, will inevitably reflect the effect on the economy.

The stock market suffered as a result of the increase of COVID-19 instances that were verified. COVID-19 had a negative and limited impact on the stock markets in China and other Asian countries early in the COVID-19 pandemic. Due to the outbreak's impacts spreading to Europe and the US, these indexes underperformed in the mid- and late periods that followed compared to the reference period. The non-domestic timeline provides evidence that the growth of COVID-19 has a detrimental effect on equities markets in Europe and the US and that this will only become worse as the virus expands [3]. In other words, stock market returns decreased as more cases were proven. The stock market responded more favorably to an increase in confirmed cases than an increase in fatalities [4]. Since most firms were unable to run their whole operations during the enforced segregation, they opted to reduce labor expenses by terminating employees. This resulted in a severe decline in economic activity and spending, which in turn decreased the flow of anticipated future financial flows. The most damaged businesses were those involved in the crude oil industry, which saw a loss of more than 60% of its market value in a single day. Comparatively, businesses in the gas and chemical sectors increased their market values and realised gains that were, on average, above 10%. Our examination of sector-level patterns identified the top performing sectors during the March 2020 crisis as being healthcare, food, software and technology, and natural gas. The most successful companies in these sectors had monthly positive returns of above 20%. Alternatively, market

capitalization fell sharply by more than 70% in several industries, including crude oil, real estate, and hospitality and entertainment [5].

The coronavirus had a disruptive effect on the entertainment sector, it caused large entertainment companies all across the world to suffer substantial losses, including Walt Disney World and Box Office, which also had to dismiss executives and staff. This pandemic's characteristics made it one of the most difficult years ever for entertainment businesses of all kinds [6]. Reduced attendance at film festivals, pauses in the release of films, and even cancellation of films are some of the effects noticed by the entertainment industry. Studios, filmmakers, theatres, and others may feel the financial consequences for months or even years to come [7]. The revenue collection base of theatres has suffered as a result of the postponement and delay of various movies that were initially slated for release in 2020. 54 movies and/or television shows have had their production halted, abandoned, or rescheduled until 2021 or 2022.

Due to COVID-19, many theatres throughout the world have closed, and the entertainment sector has not been immune to layoffs, which have been implemented by most businesses as a cost-control strategy.

The entertainment sector has undoubtedly been heavily hurt by this. However, several websites that are comparable to Netflix don't appear to have been much impacted. As its membership has grown, digital media has greatly increased in appeal [8]. Netflix acquired 16 million new licences during the embargo. People were forced to remain at home and take advantage of the quarantine period because public embargoes had been imposed in most of the world's countries. Many customers resorted to digital entertainment, or OTT platforms, when theatres, exhibition halls, and event venues shuttered and public events went online [9]. According to the BARC poll, time spent on digital streaming platforms grew by 12% during the time before the embargo, from 13 January 2020 to 2 April 2020, and the embargo period, from 20 March 2020 to 3 April 2020. 12 These issues have further motivated us to investigate how COVID-19 has affected the entertainment sector. more investigation into the data analysis of its effects at various levels. Disney, a company in the film and entertainment sector, will be the subject of this essay.

This study examines how Disney's stock price has changed and fluctuated after the COVID-19 outbreak. In order to estimate the value of the interacting variables, a VAR model was first created. To further explain the shocks and stability of the variables and to illustrate how they interact, impulse and response graphs and unit-circle tests were then created. In order to discuss whether there is considerable conditional heteroskedasticity and whether a lagged response exists, an ARMA-GARCH model was created. This results in a thorough data study and recommendations about how COVID-19 affects Disney stock prices.

The test of this paper will organize as follows: Part 2 is research design, including data sources, unit root test, VAR model specification and ARMA-GARCH model specification; Part 3 is empirical results, including VAR order selection, impulse response graph of the VAR model, ARMA order selection and ARMA-GARCH model result; Part 4 is conclusion.

2. Research Design

2.1 Data source

From "Choice Financial Terminal," a specialised data analysis and investment management programme, comes the Disney price stock used in this article. The terminal incorporates information searches and statistical analysis in one application, the financial market, and it covers equities, fixed income, mutual funds, commodities, foreign currency, macroeconomics, and other sectors. For those who participate in the financial markets, it is a professional instrument. As a result, the prices chosen by the "choice financial terminal" are quite trustworthy. Choosing the closing pricing for this software for the time period starting on January 24, 2020, and ending today, when data on the number of new illnesses since the COVID-19 pandemic was available. The yield for the day is calculated by dividing

the difference between the day's closing price and the day's closing price the day before by the day's closing price.

The "CHOICE Financial Terminal," which also contained data on the total number of new infections in China and other countries, was used to determine the cumulative number of new infections for COVID-19. The daily worldwide number of new infections was computed by subtracting the total number of new infections from one day from the total number of new infections from the next day. Stata is mostly used for data analysis in this essay in order to compare the dates in the two sets of data and determine the data for additional study.

In this study, using log return as a calculation for the stock return before talking about the data that follows. The formula for the log return is:

$$\log \text{ return rate} = \ln(1 + \text{sample return rate}) \quad (1)$$

In the previous section, describing how to compute the return based on the daily closing price. This has also been included to the Stata data.

2.2 Unit Root Test

A time series' smoothness is examined using the unit root test. When the mean and variance of a stochastic process remain constant over the course of the process, it is said to be smooth, and when the value of the skewed variance at any two periods only depends on the interval or lag not the moment at which the covariance is calculated but rather the interval between the two periods. The original data must test is displayed in Table 1 along with the outcomes of handling the series. The outcomes are displayed in Table 1.

Table 1. ADF test

Variables	t-statistic	p-value
Closing price	-0.738	0.9705
Rate of return	-17.866	0.0000***
New confirmed cases, global	-7.547	0.0000***

When t is greater than the 5% threshold of 1.96, reject the original hypothesis, then can see from Table 1 that all three sets of t-values are less than zero, which shows that Disney's daily closing price, yield and COVID-19 global daily increase in confirmed cases can be trusted, and thus can begin our modelling.

2.3 VAR Model Specification

VAR models are constructed to forecast multiple variables together in a time series, because in many cases which looking at more than one variable, but more at the relationship between multiple variables, and VAR models are constructed so that the forecasts are self-consistent, and such multivariate time series were introduced by Sims in 1980 as vector autoregressions. VAR models do not need to distinguish between endogenous and exogenous variables, and are easy to predict because the explanatory variables are lagged. To give an example of a VAR model, it is assumed that there are two time series variables $\{X_1, X_2\}$, that serve as the explanatory variables for the two regression equations. These two variables combine to create a binary VAR system, and the explanatory variables are the p-order lags of these two variables.

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

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

ε_{1t} and ε_{2t} are error terms. The impulse response function is:

$$\frac{dy_{t+s}}{d\varepsilon'_t} = \psi_s \quad (4)$$

Impulse response plots in VAR models are also important, and the impulse response function of a VAR model helps in the interpretation of VAR results. The reaction of the endogenous variables in the VAR model to modifications in the error term is likewise described by the impulse response function. The impulse response function is very useful in our analysis of VAR models.

2.4 ARMA-GARCH Model Specification

ARCH is called autoregressive conditional heteroskedasticity and was introduced because it is commonly believed that cross-sectional data are prone to the existence of heteroskedasticity and time series are often autocorrelated, but Engle in 1982 suggested that time series data also have special heteroskedasticity so this concept was introduced [10]. ARCH models consider the volatility of the variance so they can better predict the variance. An $ARCH(p)$ model can be written as:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_q \varepsilon_{t-q}^2 \quad (5)$$

Where σ_t is the forecast variance in period t . ε_t refers to the actual variance in period t . α_0 is constant [11].

GARCH emerged to refine ARCH. In an $ARCH(p)$ model, if p is large, many parameters have to be estimated so sample size is lost. In order to make the parameters to be estimated smaller and thus more accurate forecasts of future conditional variance, Bollerslev proposed the GARCH model in 1986. By adding an autoregressive component of σ_t^2 to the ARCH model, the GARCH (p, q) model is set as:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \dots + \alpha_q \varepsilon_{t-q}^2 + \gamma_1 \sigma_{t-1}^2 + \dots + \gamma_p \sigma_{t-p}^2 + \beta_t \quad (6)$$

Only need to use a GARCH model if there is heteroskedasticity.

ARMA-GARCH is used to forecast both returns and volatility and simply set the mean equation of the GARCH model to the ARMA process.

3. Empirical Result

3.1 VAR Order Selection

In this study, inserted three stationary series into our vector autoregressive system: the Disney log stock price, the worldwide log new COVID-19 confirmation case, and use multiple VARSOC selection order criteria in Stata to discover the right order for this pAR(p) model. The LR likelihood approach was used to find the maximum lag order k .

$$LR = -2(\text{Log}L_k - \text{Log}L_{k+1}) \quad (7)$$

$$LR \sim X^2_{(N^2)} \quad (8)$$

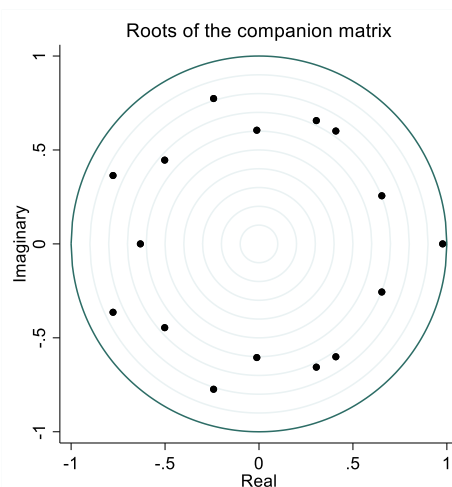
The lag order of the VAR model is regarded as mild when the LR statistic is lower than the critical value. The lag order of the VAR model is seen to be insufficient and extra lags need to be introduced as explanatory variables when the LR statistic is higher than the critical threshold. The resulting iterations, shown in Table 2, indicate that a VAR of 11 orders can be considered. At the end of the order selection then can start the next steps.

Table 2. VAR model identification

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	368.39				.00095	-1.28333	-1.27739	-1.2681
1	558.654	380.53	4	0.000	.000495	-1.93574	-1.91792	-1.89006
2	611.94	106.57	4	0.000	.000416	-2.10837	-2.07867	-2.03224
3	640.45	57.02	4	0.000	.000382	-2.19422	-2.15264	-2.08763
4	655.021	29.141	4	0.000	.000368	-2.23125	-2.17778	-2.08763
5	682.004	53.967	4	0.000	.00034	-2.31175	-2.2464	-2.14425*
6	690.595	17.181	4	0.002	.000334	-2.32783	-2.2506	-2.12987
7	699.713	18.236	4	0.001	.000328	-2.34575	-2.25664*	-2.11734
8	706.773	14.12*	4	0.007	.000325	-2.35647	-2.25548	-2.09761
9	710.863	8.1813	4	0.085	.000325*	-2.35679*	-2.24391	-2.06747
10	713.1	4.4724	4	0.346	.000327	-2.35061	-2.22586	-2.03084
11	714.748	3.2966	4	0.509	.000329	-2.34237	-2.20574	-1.99215
12	715.171	.84531	4	0.932	.000334	-2.32984	-2.18133	-1.94916

3.2 Impulse Response Graph of the VAR model

The residuals should be tested to see if they are autocorrelated and follow a normal distribution after the VAR has been estimated, as well as to see if the VAR system is a smooth process. By applying the formula in Stata with the code `varstable`, which will construct a root of the companion matrix to and verify the stability condition of the eigenvalues following the estimate of the vector autoregressive parameter. It is a balanced process if all of the eigenvalues fall within the unit circle. The presentation of the companion matrix's roots is shown in Figure 1.

**Fig. 1** Unit-circle test

All the eigenvalues are inside the unit circle and so are smooth.

Now can analyse the impulse response graph (Figure 2), which shows that fundamentally, at the beginning of the Newcastle pneumonia outbreak in 2020, investors' expectations of the market turned sour, creating a strong risk aversion, as many industries stopped working due to the Newcastle COVID-19 pandemic and people invested in stocks that fell sharply, so people were cautious in their investments. Precious metals such as gold and silver, and cryptocurrencies such as Bitcoin and Ethereum, which are largely stable in value, have become popular safe-haven assets.

In China, the US, and Europe, following the COVID-19 pandemic's fast spread, short-term investors worried, and the risk aversion of capital led to an "exodus" from the financial markets. At the same time, there was a short-term stagnation in the real economy, which in turn led to a precipitous fall in financial market indices. At the beginning of the COVID-19 pandemic, people did not know how the COVID-19 pandemic would develop, so it was normal that many people would be more risk-

averse and would invest. The rapid fall in the market was followed by a rapid rally in Disney's stock price, but this rally was not determined by the growth of its main business, which was directly reflected in its operating income and proved to be a bubble in its share price. The new COVID-19 pandemic has now been a long-standing part of the economy and the rate of growth in cases worldwide has not declined, and investors' perceptions of the COVID-19 pandemic are directly reflected in changes in stock yields as their behavior changes. When people got over it and suddenly woke up to the fact that the outbreak could be brought under control and that things were getting better and better and becoming the norm, they bought back into the stock.

From the impulse response estimates, a 1% increase in the number of new diagnoses globally at $t=0$ is associated with a short-term shock in Disney stock returns of about 0.1% in the future, with the positive and negative effects largely offsetting each other. In other words, Disney's return is not considerably harmed by the rise in new cases in a COVID-19 pandemic setting that has become accepted. It may be concluded that the COVID-19 epidemic will not have a long-term negative effect on Disney's stock price.

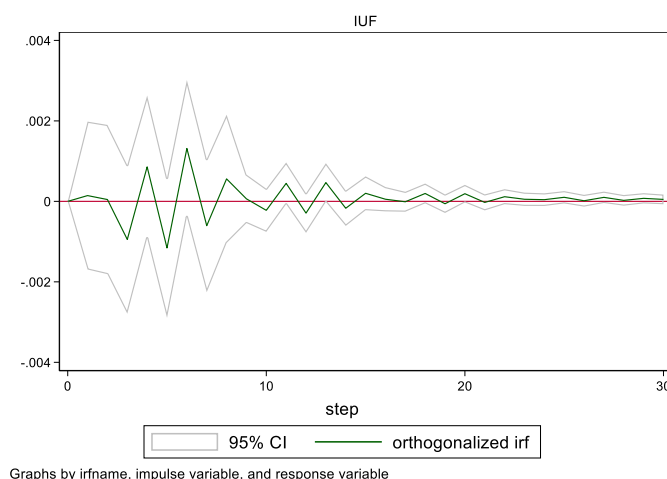


Fig. 2 Impulse and response

3.3 ARMA Order Selection

Order the Disney log-return series using PACF and ACF to determine the order of the AR component and the order of the MA component.

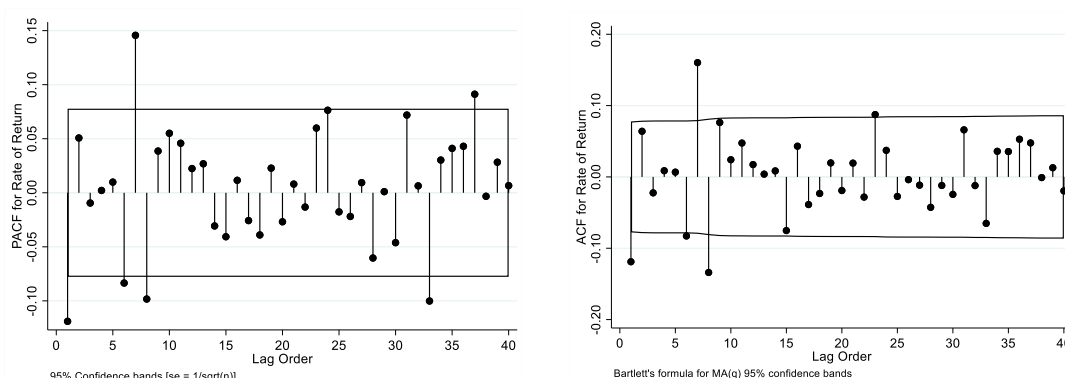


Fig. 3 PACF and ACF, Disney

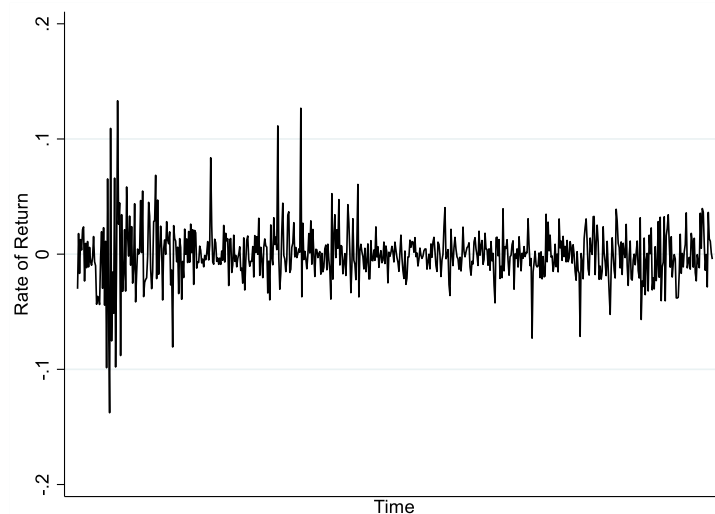


Fig. 4 Yield trend

The time series chart shows that there is a significant clustering of returns on Disney stocks, but the statistical significance of this needs to be further tested.

3.4 ARMA-GARCH Model Result

Table 3. ARMA-GARCH estimation results

Variables	(1)		(2)		(3)	
	Coefficient	Std. err	Coefficient	Std. err	Coefficient	Std. err
New confirmed cases, global						
T=0	0.9497***	0.3317	-0.1474	2.6558	1.4120	2.4924
T=-1			-0.1710	2.6113	-0.0816	4.3647
T=-2					-0.1163	4.8656
GARCH (1, 1)						
ARCH (-1)	0.0400***	0.0051	0.0363***	0.0060	0.0418***	0.0057
GARCH (-1)	0.9486***	0.0041	0.9468***	0.0063	0.9483***	0.0041
Constant	-25.4326***	4.7623	-8.074***	1.1750	-29.2021***	8.3928

This paper uses an *ARMA* (1, 1) – *GARCH* (1, 1) model. Consider the *GARCH* component's variance equation and consider if the seriousness of the COVID-19 crisis has changed stock volatility. Both the *ARCH* and *GARCH* terms in columns (1) to (3) are significant, meaning that there is significant conditional heteroskedasticity in Disney stock returns, allowing for *GARCH* modeling. Estimates of the external explanatory variables show that a 1% increase in the number of new global diagnoses at $t=0$ is associated with a 0.9497 unit increase in the volatility of Disney stock returns. After adding the lagged term for the number of new diagnoses, the coefficient is no longer significant, indicating that there is no lagged response and that financial markets are more efficient. This shows that the COVID-19 epidemic had no effect on Disney stock.

4. Conclusion

This article found that Disney stocks were more affected by the early stages of the COVID-19 pandemic outbreak, at the beginning of which the highly contagious COVID-19 pandemic virus halted operations in many parts of the world and many more companies were at risk of collapse, causing a short period of panic. This led many investors to withdraw from the stock market because of the high risks involved and to invest in precious metals, bonds, and other value-protected investments. And when the COVID-19 pandemic starts to be contained and people realize that it is

not as scary as they thought it would be, investors will return to trading. At this point, the market trend will occur a rapid rebound after a precipitous fall, and people with different investment styles will use different investment strategies. Those who are bold enough to take advantage of the drop straight away, will reap the dividends of this market pullback. Investors who lean conservative, will also be able to observe the changes in trading and thus change their capital distribution. In the latter stages of the COVID-19 pandemic, investors should consider the long-term impact of this event on the sector as a whole and make a medium to long-term position in order to generate stable income. As people realize that the COVID-19 pandemic has been running the economy for a long time, they should focus on medical care, pharmaceuticals, vaccine research, etc. These sectors have more investment potential than others, and the government will provide policies and funding to support these sectors. Therefore, the COVID-19 pandemic will not have much long-term impact on Disney's stock.

The global changes brought about by the COVID-19 pandemic are enormous, in any respect. Especially the economy. While the COVID-19 pandemic has affected each industry differently, consider its short- and long-term effects. This paper examines the relationship between the global daily change in the number of people added to the COVID-19 pandemic and Disney stock returns, with a particular focus on the volatility of Disney stock returns. The findings of the paper's analysis of the data using Stata modelling indicate that the COVID-19 pandemic has an effect on Disney's return in the near term but has no lasting influence.

References

- [1] Shehzad K, Liu X, Bilgili F, et al. COVID-19 and Spillover Effect of Global Economic Crisis on the United States' Financial Stability. *Frontiers in Psychology*, 2021, 12.
- [2] Baker S R, Bloom N, Davis S J, et al. The Unprecedented Stock Market Impact of COVID-19 [J]. *NBER Working Papers*, 2020.
- [3] He Q, Liu J, Wang S, et al. The impact of COVID-19 on stock markets. *Economic and Political Studies*, 2020, 8(3): 14.
- [4] Ashraf B N. Stock markets' reaction to COVID-19: Cases or fatalities? *Research in International Business and Finance*, 2020, 54: 101249.
- [5] Mazur M, Dang M, Vega M. COVID-19 and the march 2020 stock market crash. Evidence from S&P1500. *Finance Research Letters*, 2021, 38.
- [6] Nhamo G, Dube K, Chikodzi D. Implications of COVID-19 on Gaming, Leisure and Entertainment Industry. 2020.
- [7] Moon, S. Effects of COVID-19 on the Entertainment Industry. *Idosr Journal of Experimental Sciences*, 2020, 5(1): 8–12.
- [8] Mahendher S, Sharma A, Chhibber P, et al. Impact of COVID-19 on Digital Entertainment Industry. 2021.
- [9] Mcavoy K. Bloomberg mixes business with news; company offers variety of programs, video, wire reports with custom features. (Bloomberg News) (News Services 1997) (Brief Article).
- [10] Engle R F. Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of U.K. Inflation. *Econometrica*, 1981, 50(4): 987-1008.
- [11] Chen G, Firth M, Rui O M. The dynamic relation between stock returns.