

THE CONNECTION BETWEEN THE GOLD MARKET AND THE FOREIGN EXCHANGE MARKET OF THE BRICS COUNTRIES

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ABSTRACT

In present BRICS economies are important because the economic growth rates will be higher than the growth rates of the United States and the European countries in the near future. The purpose of this study is to demonstrate the connection between gold prices and the foreign exchange markets of the BRICS countries (Brazil, Russia, India, and China). The study used daily data from 2020 to 2022 during the COVID-19 pandemic. The DCC GARCH (1,1) model estimation method was used. The results of the study on the correlation of exchange rates and gold prices revealed that there was a correlation within the members of the BRICS group except China and gold price. The relationship between the volatility of the return of exchange rate within the BRICS group and the return of the gold price. The returns of each variable are correlated in the same direction, but the size is different. The dynamic coefficient, or price of gold, has the least relation to exchange rates with the BRICS members. and the South African rand, the most relationship between BRICS exchange rates and gold prices.

Keywords: Brics, Dcc-Garch Model, Exchange Rate, Gold, COVID-19

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INTRODUCTION

Financial markets now play an increasingly crucial role in connecting the global economy in terms of international commerce and investment, including both foreign direct investment and financial market investment. Money is an important medium of exchange, and different nations throughout the world have distinct monetary systems, which is why the foreign exchange rate system was developed. Exchange rates tend to become increasingly volatile and significant to a country's economy because of growing global economic ties (Rakpraisuthepsiri, 2019). Additionally, it is evident that the Contagion effect starts to play a greater role in explaining the changes in exchange rates between countries following the financial crisis, particularly the Asian financial crisis. This is due to the strong connections between trade and capital movements, which means that the exchange rate of one nation affects the exchange rate of other countries. In particular, the exchange rates of the region's countries or of countries that have assembled to conduct commercial activity (Rakpraisuthepsiri, 2019).

Currently, a significant crisis like the spreading of COVID-19 is seen as a major threat to the global community. It has been upgraded by the World Health Organization (WHO) to "Global Pandemic Situation". Which, in medical terms, indicates that the disease's transmission may be localized to a specific area rather than being more widespread than anticipated. The health crisis that is currently underway is the worst in a century (Khumsaen, 2021). The economy has shrunk more because of the coronavirus pandemic than it has in any other 60-year period since 1870, according to a World Bank analysis (2020). The destruction of the Coronavirus outbreak has generated instability in all industries in 2021, with such violence hitting emerging and developing countries (World Bank, 2020).

The BRICS economies consists of five countries: Brazil, Russia, India, China, and South Africa. This is a group of countries that have transitioned from a developing market to a market with potential and growing rapidly (O'Neill, 2001). In this group want to import commodities other than gold because South Africa is a major gold exporter. the BRICS member countries' growth rate would accelerate in the near future, possibly exceeding the overall growth rate of the United States and the European countries by 2030. (Larionova, 2020)

Since many studies suggest that gold is a safe investment, for instance, research by Dee and Zheng (2013) revealed that gold may be a decent hedging investment for a long time. As per Beckmann et al. (2015) research, gold serves as a hedge and haven. With research in the same direction as Hillier Draper and Faff (2006), McCown and Zimmerman (2006), Kaul and Sapp (2006).

In summary, this study demonstrates a connection between the foreign exchange market and the gold market, to put it briefly. Data on the exchange rates of the BRICS was used to investigate it during the coronavirus outbreak. It is a developing market country with one of the world's highest GDP values. The gold market makes use of gold pricing data (gold spot). This is because, even though futures prices are included in spot prices, a recent study discovered that they are not an impartial forecast of future spot prices (Arouri et al. 2012).

REVIEW OF LITERATURE

The Dynamic Conditional Correlation GARCH model (DCC-GARCH) was first introduced by Engle and Sheppard (2001) and can be viewed as an extension of the CCC-GARCH model presented by Bollerslev (1990). The difference between the CCC-GARCH and DCCGARCH is that the DCC-GARCH allows the correlation structure to be dynamic and vary over time. The DCC-GARCH model is easier to compute than many other complex MGARCH models, where the most distinguished advantage is that the number of parameters that are estimated in the correlation process are independent on the number of series that are to be estimated, which renders in a large computational advantage when estimating large covariance matrices (Engle 2002).

Related research

There have been significant research and several dimensions explored in order to analyze the correlation. The relationship between exchange rates is usually studied in conjunction with other factors, such as Delgado et al. (2018), a study on the relationship between oil prices, the stock market, and the exchange rate in Mexico Exchange, which shows that when the price of oil rises, the exchange rate rises as well. Beckmann et al. (2015) analyzed the reasons and patterns of volatility between gold and the exchange rate and discovered that the link between the two could not be explained in the short run because the exchange rate had a negative influence on the price of gold. The impact was negative after one day, but positive after two days. Sinchaikij (2011) investigated exchange rate volatility modeling and the gold price in Thailand. It was discovered that exchange rate volatility had little effect on gold prices. However, the volatility of the gold price impacts exchange rates, and the transmission of volatility between exchange rates and other parameters has been investigated by Panda and Deo (2014), Rajhans and Jain (2015), Wang and Lee (2016), Jebran and Iqbal (2016), Sui et al (2021).

RESEARCH METHODOLOGY

Data

The data used in this research are based on secondary data from BRICS international exchange rates: BRL/USD, RUB/USD, INR/USD, CNY/USD, and ZAR/USD, as well as gold prices. In this study, the data will be organized in the form of the rate of return using data spanning from January 1, 2020, to December 31, 2022, by calculating the ratio of the variables in log form.

Data analysis

The DCC-GARCH Model is used in this study to examine whether there is a connection between the two marketplaces, And the details of the variables are shown in Table 1.

Table 1 Description of variables used in the study.

i	Description
1	The exchange rate between Brazil and the US dollar (BRL/USD)
2	The exchange rate between Russia and the US dollar (RUB/USD)
3	The exchange rate between India and the US dollar (IRN/USD)
4	The exchange rate between China and the US dollar (CNY/USD)
5	The exchange rate between South Africa and the US dollar (ZAR/USD)
6	Gold market (Gold)

Model estimation

Step 1 Unit Root Test

The majority of time series data analysis use stationary time series data, which are in a condition of statistical equilibrium and do not fluctuate over time in terms of variance or mean. Most time series data analyses are based on stationary time series data, which means that the data are statistically equilibrium at the time of analysis. This suggests that the time series data variance and mean do not vary over time. In addition, most of the assumptions used for data analysis will have an error term with constant variance (homoscedastic). In some timeseries data, the variance of the error value changes over time depending on the magnitude of the past values (heteroskedastic), so that the variance of the regression error depends on the volatility of the error. According to the preceding, the unit root test must first be tested with the Augmented Dickey Fuller test (ADF-test). The ADF-test technique has the following equation form.

None
$$\Delta Y_t = \theta Y_{t-1} + \sum_{i=1}^p \phi_i \Delta Y_{t-i} + \varepsilon_t \quad (1)$$

Intercept
$$\Delta Y_t = \alpha + \theta Y_{t-1} + \sum_{i=1}^p \phi_i \Delta Y_{t-i} + \varepsilon_t \quad (2)$$

Intercept and Trend
$$\Delta Y_t = \alpha + \beta T + \theta Y_{t-1} + \sum_{i=1}^p \phi_i \Delta Y_{t-i} + \varepsilon_t \quad (3)$$

t is the time index,

α is an intercept constant called a drift,

β is the coefficient on a time trend,

θ is the coefficient presenting process root, i.e. the focus of testing,

p is the lag order of the first-differences autoregressive process,

ε_t is an independent identically distributed residual term.

The difference between the three equations concerns the presence of the deterministic elements α (a drift term) and βt (a linear time trend).

The focus of testing is whether the coefficient γ equals to zero, what means that the original ADF Time Series process has a unit root; hence, the null hypothesis of $\gamma = 0$ (random walk process) is tested against the alternative hypothesis $\gamma < 0$ of stationarity. More detailed, the null and alternative hypotheses corresponding to the models above are:

H_0 : Data is unstable.

H_1 : Data is stable.

At the 95% confidence level, if the p-value is less than 0.05, it can be concluded that the hypothesis is rejected. Therefore, it shows that the data has a stable nature. In contrast, if the p-value is greater than 0.05, it can be concluded that the hypothesis is accepted, therefore the data has a stable appearance.

The DCC-GARCH Model is then used to evaluate the data to look at the transmission of volatility and the relationship between gold prices and exchange rates. Which in the following form:

$$Q_t = (1 - \theta_1 - \theta_2) \Gamma + \theta_1 \eta_{t-1} \eta'_{t-1} + \theta_2 Q_{t-1}$$

where θ_1, θ_2 is a scalar parameter used to look at the effects of random variables at time (t-1) (Previous Standardized Shocks), And a conditional relationship with a dynamic change at time (t-1) (Previous Dynamic Conditional Correlation) to a conditional relationship with a dynamic change at time (t) (Dynamic Conditional Correlation).

Q_t is the conditional relationship of the variables to be studied whose movements change with changes in time.

η_t is a sequence of random vectors. Independently and Identically Distributed

$$\eta_t^i = \frac{\varepsilon_t^i}{\sqrt{h_t^i}}$$

(iid) by

where i represents the gold index and exchange rates in the BRICS are BRL/USD RUB/USD INR/USD CNY/USD and ZAR/USD.

RESULTS

This section consists of three parts. Firstly, we show descriptive statistics. The second is a stationary test with the ADF-test. And the last part is part of testing via the DCC model.

The descriptive statistic of the data used in the study is the return of the exchange rate of the BRICS members to the US dollar and the return of the gold price. The average return on the exchange rate among the BRICS members is between -0.000351 (BRL) and -0.000000151 (CNY). The average return of gold is 0.000225. The maximum return of the exchange rate for the BRICS members is between 0.018224 (CNY) and 0.0651049 (RUB), and the minimum return is between -0.646711 (RUB) and 0.012170 (CNY). The standard deviation of the return on the exchange rate among the BRICS members is in the range of 0.00295 (CNY) to 0.052798 (RUB), and gold is at 0.010917. Looking at the standard deviation, the country most exposed to the exchange rate is Russia, and the lowest is China. The skewness of the data found that the data tends to be left-skewed most of the time. However, the skewness is in the range of -0.3563 to 0.0528, and the standard deviation tends to zero. Therefore, it is inferred that the data set has a normal distribution (Table 2).

Table 2 Descriptive Statistic.

	BRL	RUB	INR	CNY	ZAR	GOLD
Mean	-0.0035	-0.0002	-0.0002	-0.0015	-0.0002	0.0002
Maximum	0.0622	0.6511	0.0187	0.0182	0.0350	0.0580
Minimum	-0.0603	-0.6467	-0.0294	-0.0122	-0.0421	-0.0499
Std. Dev.	0.0120	0.0528	0.0041	0.0030	0.0101	0.0109
Skewness	0.0631	-0.1242	-0.3256	0.4663	-0.3563	-0.2711
Kurtosis	4.8478	118.4264	8.6658	8.4783	3.8957	7.0723
Jarque-Bera	111.7748	434118.3	1059.771	1006.218	42.6882	549.9165
Probability	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Table 3 depicts the stationary test with the ADF-test. The null hypothesis (H0) of this test is that the data is nonstationary. According to the study, the return of the BRICS members' exchange rates and the return of gold prices are both stationary and significant at 0.05.

Table 3 Stationary test with ADF-test.

Variable	Trend and Intercept		Intercept		None	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
BRL	-1.058307*	-29.56745	-1.055999*	-29.51869	-1.055110*	-29.51097
RUB	-2.48646*	-19.64061	-2.147634*	-19.64788	-2.147333*	-19.65806
INR	-1.170794*	-33.16059	-1.170410*	-33.17013	-1.167742*	-33.09859
CNY	-1.059659*	-29.59709	-1.055656*	-29.50030	-1.055656*	-29.51924
ZAR	-1.047251*	-29.23315	-1.047131*	-29.24792	-1.046499*	-29.24889
GOLD	-1.020774*	-28.47829	-1.019973*	-28.47372	-1.019539*	-28.47960

After performing stationary testing, the DCC-GARCH model is used to estimate. In table 4, the results from the estimation using the DCC-GARCH model are divided into 2 parts: the first part is the equation showing the relationship between the variables. (Conditional Mean Equation) and the second part, the Conditional Variance Equation.

The results found that the exchange rate returns in the BRICS countries are correlated in the same direction, with the exception of China, which is a country that is severely affected by the COVID-19 epidemic. As a result, China's economy has halted, and international trade is declining. China's exchange rate is depreciating compared to the other members of the BRICS. If the return of the exchange rate within the group increases by 1 percent, the yield on the renminbi rises or appreciates by about 0.000022 percent. Gold is a safe asset; the return of the gold price has correlated in different with the return of the BRICS members' exchange rates.

Table 4 DCC-GARCH parameter estimation.

Variable	Conditional Mean Equation			Conditional Variance Equation		
	μ_i	x_{t-1}	MA	ω_i	α_i	β_i
BRL	-0.000261 (0.000399)	0.300529 (0.583163)	-0.357862 (0.572171)	0.000008 (0.000001)	0.070473 (0.004845)	0.876421 (0.012034)
RUB	-0.000138 (0.000263)	-0.485782 (0.506333)	0.094112 (0.692814)	0.000001 (0.000009)	0.130975 (0.065467)	0.868025 (0.103860)
INR	-0.000161 (0.000108)	0.253913 (0.361982)	-0.346032 (0.356402)	0.000001 (0.000001)	0.089993 (0.020961)	0.857446 (0.016410)
CNY	0.000022 (0.000083)	0.114020 (0.199754)	-0.183870 (0.203162)	0.0000001 (0.000000)	0.038761 (0.016570)	0.941100 (0.017975)
ZAR	-0.000184 (0.000359)	-0.572293 (0.137632)	0.518343 (0.140209)	0.000008 (0.000000)	0.077142 (0.005696)	0.842234 (0.013974)
GOLD	0.000006 (0.000291)	0.871497 (0.111794)	-0.908015 (0.098326)	0.000013 (0.000000)	0.090987 (0.007928)	0.799283 (0.021141)

The relationship between the volatility of the return of exchange rate within the BRICS group and the return of the gold price is shown in Table 5. This table conditionally represents the dynamic correlation. The returns of each variable are correlated in the same direction, but the size is different. The dynamic coefficient, or price of gold, has the least relation to exchange rates with the BRICS members. and the South African rand, the most relationship between BRICS exchange rates and gold prices.

Table 5 Dynamic Conditional Correlation.

	BRL	RUB	INR	CNY	ZAR	GOLD
BRL	1.00000000					
RUB	0.21228675	1.00000000				
INR	0.29437341	0.24173522	1.00000000			
CNY	0.18415609	0.12030082	0.22080503	1.00000000		
ZAR	0.45197954	0.31591081	0.38706486	0.24802975	1.00000000	
GOLD	0.07638898	0.01396646	0.02954002	0.09009508	0.05261223	1.00000000

DISCUSSION AND CONCLUSION

The results of the study on the correlation of exchange rates and gold prices revealed that there was a correlation within the members of the BRICS group except China and gold price. If the return of the exchange rate within the group increases by 1 percent, the yield on the renminbi rises or appreciates by about 0.000022 percent. Gold is a safe asset; the return of the gold price has correlated in different with the return of the BRICS members' exchange rates. The relationship between the volatility of the return of exchange rate within the BRICS group and the return of the gold price. The returns of each variable are correlated in the same direction, but the size is different. The dynamic coefficient, or price of gold, has the least relation to exchange rates with the BRICS members. and the South African rand, the most relationship between BRICS exchange rates and gold prices.

According to the findings, gold remains a safe-haven asset, as evidenced by research by Panda and Deo (2014), Rajhans and Jain (2015), Wang and Lee (2016), Jebran and Iqbal (2016), Sui et al (2021). Unlike exchange rates, which alter and fluctuate constantly.

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