An Analysis on Trading Behaviors of Currency Futures: Evidence from BRICS Countries

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Abstract

This study uses Markov-switching vector autoregressive analysis (MSVAR) to examine the interaction between the trading activities of hedgers and speculators for the currency futures of four BRICS emerging countries traded on the Chicago Mercantile Exchange (CME). First, we investigate the effect of net positions by type of trader to test the relation between currency futures volatility and the trading positions. We employ Granger Causality tests to analyze lead and lag relations between currency futures volatility and the trading positions. Second, we investigate the dynamic interactions between futures price volatility and traders' trading activities using MSVAR under a generalization of Hamilton's model to a vector auto-regressive framework we can identify regime shifts occurring mainly simultaneously. Main finding is that speculators and day traders destabilize the market for futures. Whether hedgers stabilize or destabilize the market is inconclusive. The results suggest that speculators' demand for futures goes down in response to increased volatility.

JEL Classification: F3, G1

Keywords: Currency futures, Hedgers, Open interest, Trading behaviors, Markov Switching VAR

1. Introduction

The issue of the linkage between trading behaviors for hedgers and speculators, and price volatility has long been discussed in financial academic researches which can be traced to Osborne (1959). Karpoff (1987) reviews a series of studies on the relation between trading volume and price volatility in financial markets. This study intends to examine the interaction between the trading activities of hedgers and speculators for currency futures markets.

Leuthold (1983) indicates trading volume can largely reflect speculators who are mainly day traders w and seldom hold their positions overnight and open interest is the number which has not been close out at any point of time can be used as a proxy of hedgers. Bhargava and Malhotra (2007) provide evidence that speculators and day traders, as proxied by the futures volume, destabilize the currency market while the role of hedgers, as proxied by the open interest. Grammatikos and Saunders (1986) find a positive relation between trading volume and futures currency price. In contrast, Bessembinder and Seguin (1992; 1993) document that volatility is negatively related to expected futures-trading activity. Guru(2010) tests the impact of currency futures trading on volatility and returns of underlying spot exchange rates and finds both speculative and hedging activities in the futures market for currency have no influence on the volatility in the underlying exchange markets. Chang et al. (2013) find hedging trading exerts a negative impact and a positive and nonlinear impact of speculators' trade size on price discovery in futures markets. Clements and Todorova(2015) investigate how news volume and sentiment, shocks in trading activity, market depth and trader positions unrelated to information flow covary with realized volatility and doesn't find a strong link between volatility and trader positions.

Accordingly, three purposes of this paper are to expand the empirical results and provide innovational evidences in currency futures markets. This study uses Markov-switching vector autoregressive analysis (MSVAR) to examine the interaction between the trading activities of hedgers and speculators for the currency futures of four BRICS emerging countries. The BRICS members are all developing or newly industrialized countries, but they are distinguished by their large, fast-growing economies and significant influence on regional and global affairs; all five are G-20 members. The currency futures of four members of the BRICS emerging countries include Brazilian Real, Russian Ruble, Chinese Renminbi and South African Rand. The first purpose is to examine the causal relationship between trading activities and the volatility of futures prices. According to Bhargava and Malhotra (2007), this study investigates whether the futures trading activity for speculators and hedgers stabilize or destabilize in currency futures markets, and discusses how the increase or decrease in price volatility has an impact on the demand for futures by speculators and hedgers. The second purpose is to investigate to determine whether the sequential arrival of information hypothesis exists in currency futures market. A number of researchers have addressed the issue of volatility and volume in general, but very few have done this research for currencies. Studying the relationship between exchange rates and futures trading activity using both open interest and volume to measure trading activity allows this paper to separate hedgers from speculators and day traders. Whereas open interest is a measure of hedging positions, volume gives a measure of speculating activities.

This paper contributes to the line of research that tries to identify who trades futures from currency futures data that is readily available in every derivative market in the world, namely, the volume of trading and the open interest. This research is important because it gives insight into the relationship between volatility and futures activity. Economists believe that futures markets provide a medium for hedging, help in price discovery, and improve overall market efficiency. On the other hand, some researchers suggest that futures markets lead to higher speculation and, therefore, cause the markets to destabilize. This study provides insights into how the trading activities of both hedgers and speculators impact volatility and, hence, market stability. In addition, the study also answers the question of whether the demand for futures is positively or negatively correlated to increased volatility and, therefore, draws inferences on investors' reaction to increased volatility.

2. Data and Methodology

2.1 Data

All futures contracts data are obtained from the Commodity Research Bureau (CRB) database. For each of the currency futures, the nearby contract is used, rolling over to the next contract on the ten trading days prior to contract expiration. This is to avoid any distortion effects of estimating futures volatility with too short of futures expiration. In order to adjust for any distortion caused by rollovers, daily futures returns are calculated with the price data from the identical contract. Thus, on rollover days, prices are extracted for both the nearby and first-deferred contract, and the daily returns on the days after rollover are measured with the same contract month. The same has been done for both volume and open interest series of each currency. This is a standard procedure to eliminate any distortion effect of expiration and rollovers used by many prior studies (e.g. Rougier, 1996; Kim, Szakmary, and Schwarz, 1999; Kim and Kim, 2003; Holmes and Rougier, 2005).

2.2 Garman-Klass volatility estimator

This article uses Garman-Klass volatility to examine the daily futures price variability. We calculate the Garman-Klass volatility estimator as follows:

$$\sigma_t^2 = 0.511(u-d)^2 - 0.019[c(u+d) - 2ud] - 0.383c^2 \quad (1)$$

where u= ln (high price/ opening price on day t)

d= ln (low price/ opening price on day t)

c= ln (settlement price/ opening price on day t)

Garman-Klass volatility estimator is classified as range estimator because it based on daily trading range of information.

2.3 Markov-switching in a univariate framework

We will consider here models in which the regime is determined by an underlying unobservable stochastic process (st), i.e. in which one assigns probabilities to the occurrence of the different regimes. In its most popular version, which we will use here, such a model assumes that the process st is a first-order Markov process (Hamilton, 1994). Hamilton (1989) explores the consequences of specifying that first differences of the observed series follow a nonlinear stationary process rather than a linear stationary process.

We consider a model of volatility change (Δy_t) as a Markov-switching-mean model such as :

$$\Delta y_t - \mu(s_t) = \alpha_1 [\Delta y_{t-1} - \mu(s_{t-1})] + \alpha_2 [\Delta y_{t-2} - \mu(s_{t-2})] + \alpha_3 [\Delta y_{t-3} - \mu(s_{t-3})] + \alpha_4[\Delta y_{t-4} - \mu(s_{t-4})] + u_t \quad (2)$$

where the conditional mean $\mu(s_t)$ switches between two states :

$\mu(s_t) = \mu_1 < 0$, if $s_t = 1$ ('low volatile') (2a)

$\mu(s_t) = \mu_2 > 0$, if $s_t = 2$ ('high volatile') (2b)

and the variance of the disturbance term is allowed to differ between the three regimes : u_t~NID $(0,\sigma^2[s_t])$,

with $\sigma^2[s_t] = \sigma^2{}_1$, if $s_t = 1$ (2c)

$\sigma^2[s_t] = \sigma^2{}_2$, if $s_t = 2$ (2d)

Besides, (2c), (2d) imply that we allow for Markov-switching heteroskedasticity, that is the variance of errors can differ between the two regimes. Similarly, after the change in regime there is an immediate one time jump in the variance of errors.

2.4 Markov-switching VAR framework

Hamilton's approach can be extended to a regime-switching VAR (Krolzig, 1998). We utilize the VAR model to document the interactions among trading volume, open interest, and price volatility. The expiration day (time-to-maturity) for the futures contract is included as an exogenous variable.

A VAR model with regime switching (MS-VAR) is such as :

$$z_t = \nu(s_t) + A_1 z_{t-1} + A_2 z_{t-2} + A_3 z_{t-3} + ... + A_j z_{t-j} + \varepsilon_t \quad (3)$$

where z_t = vector of volatility, open interest and trading volume, j is the order of the VAR, and s_t denotes an unobservable discrete regime. We assume that s_t follows and ergodic Markov process. We allow for the intercept and the variance to differ between regimes. We can also consider a switching mean specification as in the univariate case. The selection of the optimal distribution lag-length structure in each of three equations will be employed by Schwarz Bayesian criterion (SBC), the smaller the value of SBC, representing the more optimal lag values. On the other hand, in order to consider the residuals of each equation are corresponding with White-noise, we also conduct residual serial correlation LM test to select the most optimal lag-length. We use Granger causality to investigate the causal relationship among the three endogenous variables as well as examine the impact that an additional, exogenous variable has upon the endogenous variables.

Before estimating the Markov-Switching VAR model, we should do unit root tests first. Therefore, we will use the Augmented Dickey-Fuller (ADF) test, which was developed by Dickey-Fuller (1979), to test for the stationary of the time series, since the Markov-Switching VAR model is more appropriate when the time series is stationary. The unit root test, Phillips-Perron (P-P) test, is also undertaken as an alternative test in this article to complement the Dickey-Fuller test. Some scholars argue that P-P test is more efficient than ADF test. As Booth et al. (1997) pointed out, the Phillips-Perron test is measured on the assumption that the time series to be investigated is autocorrelated and it is reported to be robust with respect to heteroscedasticity. Sims (1980) postulated that the purpose of VAR analysis is to address the interrelationship among the variables, but not the parameter estimates, so there is no need for detrending or nondetrending when doing unit root tests.

As Chen and Daigler (2008) indicated, when the original form of VAR model has many parameters, it is difficult to describe the feedback effects and interrelation results from each coefficient of the variables in the system. Accordingly, in order to better understand the dynamic linear interrelation among trading volume, open interest, and volatility, Granger causality tests, variance decompositions, and impulse response functions are also conducted in this article, which are developed from the original form of VAR model.

3. Results

This section details the empirical results of the analysis discussed in the prior chapters of this study. Included are descriptions of the summary statistics of samples, the contemporaneous correlations among three endogenous variables, and results of Granger causality tests, forecast error variance decompositions, and impulse response functions by applying MSVAR models.

3.1 Statistics and Data Analysis

Table 1 provides the summary statistics of the mean, standard deviation, skewness and kurtosis for the futures trading volume open interest and price volatility. The currency futures of four members of the BRICS emerging countries include Brazilian Real Futures, Russian Ruble Futures, Chinese Renminbi Futures and South African Rand Futures traded in Chicago Mercantile Exchange (CME) which is one of the largest options and futures exchanges. The entire sample of data used in this paper consists of the daily figures of currency futures price, trading volume and open interest for the futures contracts with the futures mentioned above from September 1st, 2006 to September 30th, 2011. As stated above, we use both volume (to capture speculative activity) and open interest (to capture hedging activity) as proxies for demand for currency futures. Intra-day volatility is measured using the Garman-Klass volatility estimator. Figures 1 to 4 show the time paths of currency futures settlement price, trading volume, open interest and price volatility. In year of 2008, all the currency futures price drop by a staggering 30% within several months except Chinese Renminbi due to the financial turmoil. According to both tests the data series of open interest, trading volume and volatility are all stationary since the null hypothesis which the time series is nonstationary is rejected at the 1% significant level for futures price volatility, trading volume, and open interest.

3.2 Contemporaneous correlation

Table 2 presents the correlations among the measures of investors' trading activities by speculators and hedgers, and the measure of futures price volatility. As expected, the correlation between trading volume and price volatility is positive, implying that the more trading activity by speculators the more futures price volatility and speculators' trading activity destabilize market.

Meanwhile, the correlation between open interest and the measure of price variability is also positive. This implies that when open interest increases, then futures price volatility increases, indicating that the trading activity by hedgers can also destabilize the market.

Furthermore, the correlation between trading volume and open interest is positive, implying that the trading activities by speculators and hedgers may affect each other in the same direction.

Table 1. Summary statistics of futures trading volume, open interest and price volatility

	Volume	Open interest	Volatility
Panel A: Brazilian Real			
Mean	428.0836	8371.4830	0.3801
Std. Dev.	1565.8250	9900.9710	0.0039
Skewness	11.5258	2.1246	2.9672
Kurtosis	175.3354	6.3162	59.8944
Panel B: Russian Ruble			
Mean	1096.4630	29478.8400	0.3799
Std. Dev.	2409.0870	26720.4200	0.0040
Skewness	7.5929	1.8767	1.2979
Kurtosis	81.2573	5.2500	18.8260
Panel C: Chinese Renminbi			
Mean	37.1901	717.7871	0.3800
Std. Dev.	60.9193	362.4274	0.0006
Skewness	3.7850	0.5842	1.4509
Kurtosis	23.5373	2.6271	19.7152
Panel D: South African Rand			
Mean	421.8031	5405.5730	0.3803
Std. Dev.	941.2059	2189.1760	0.0061
Skewness	5.7597	0.7903	-0.4046
Kurtosis	46.2021	4.2600	10.8605

The data covers the periods from September 1st, 2006 to September 30th, 2011, including 1280 sample Volatility stands for the Garman-Klass volatility estimator.

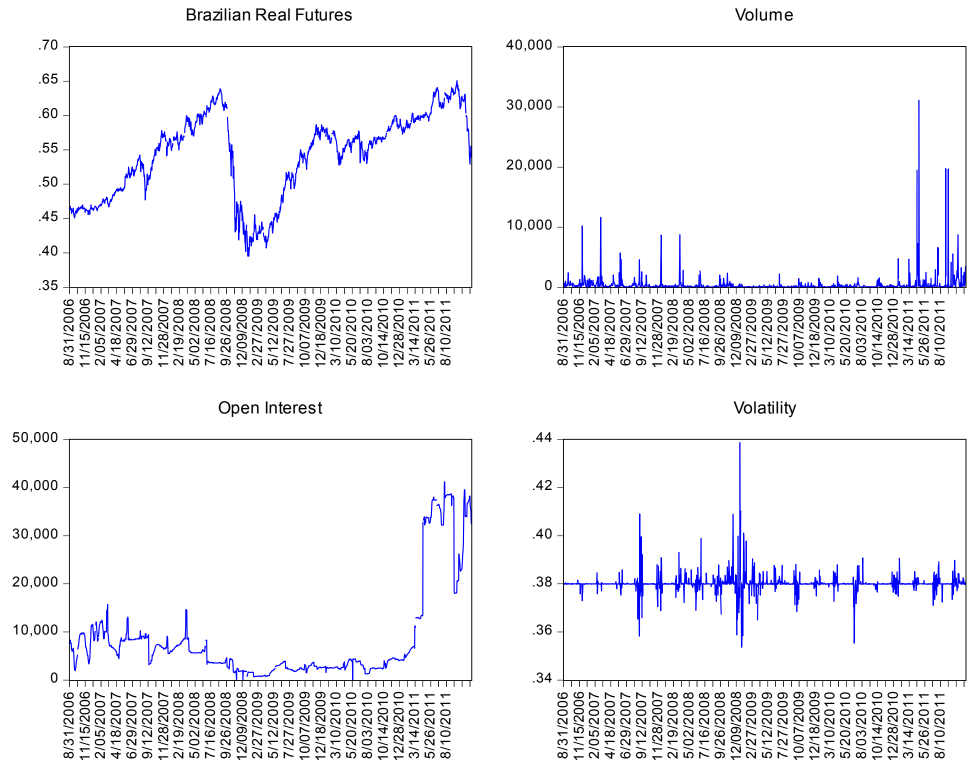

Figure 1. Time paths of currency futures price, trading volume, open interest and price volatility - Brazilian Real

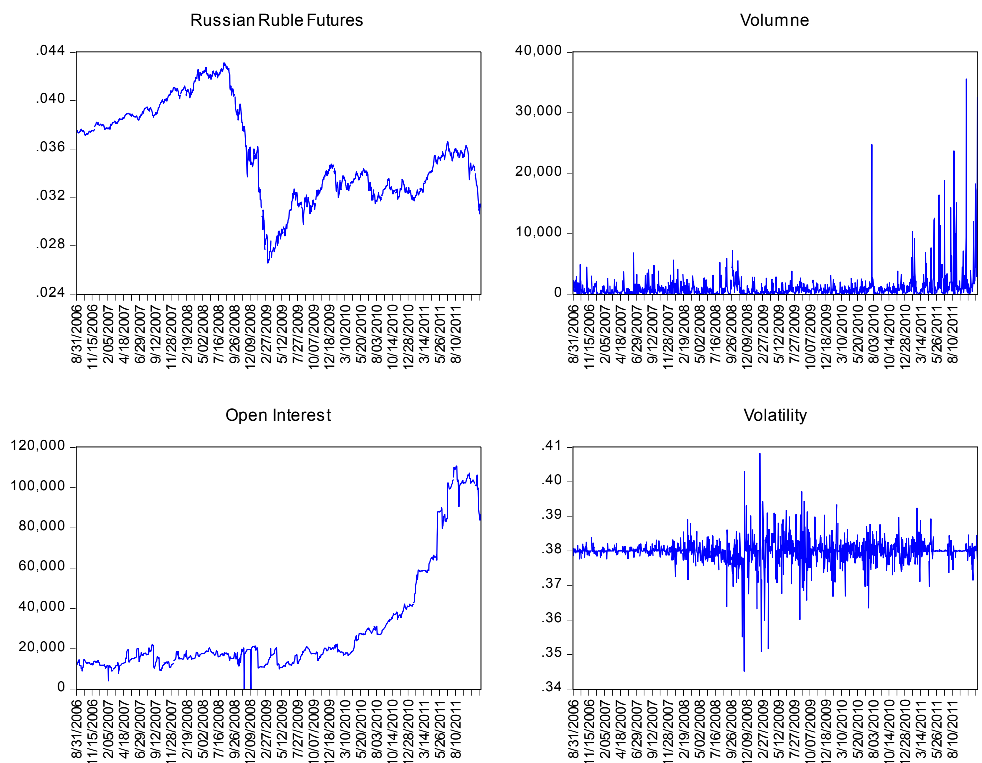

Figure 2. Time paths of currency futures price, trading volume, open interest and price volatility - Russian Ruble

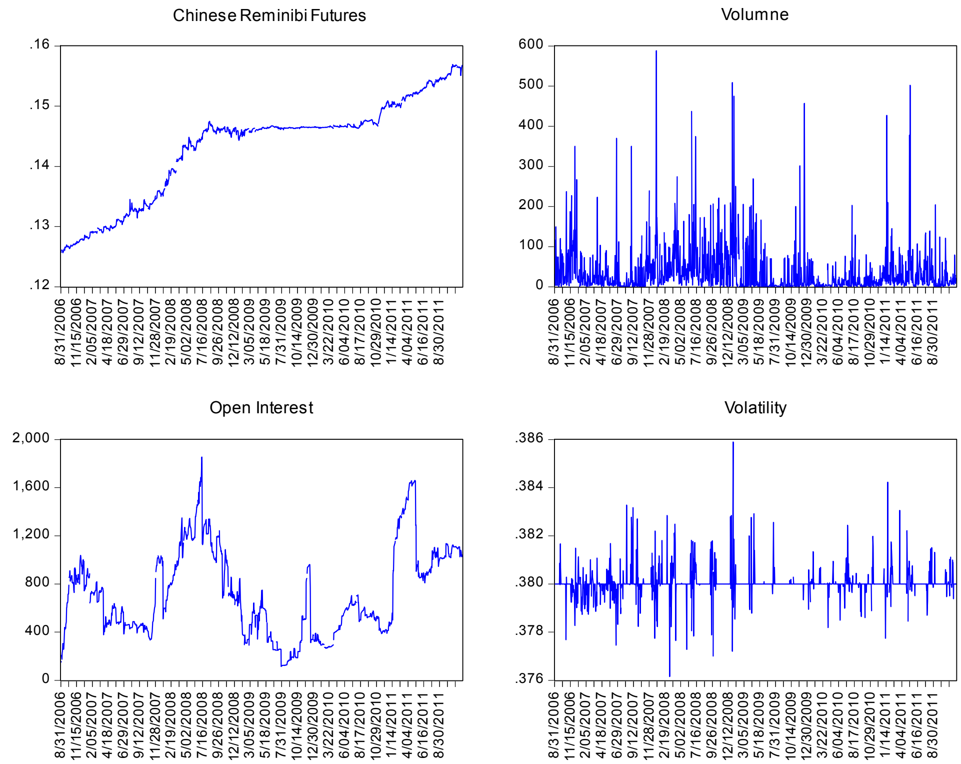

Figure 3. Time paths of currency futures price, trading volume, open interest and price volatility - Chinese Renminbi

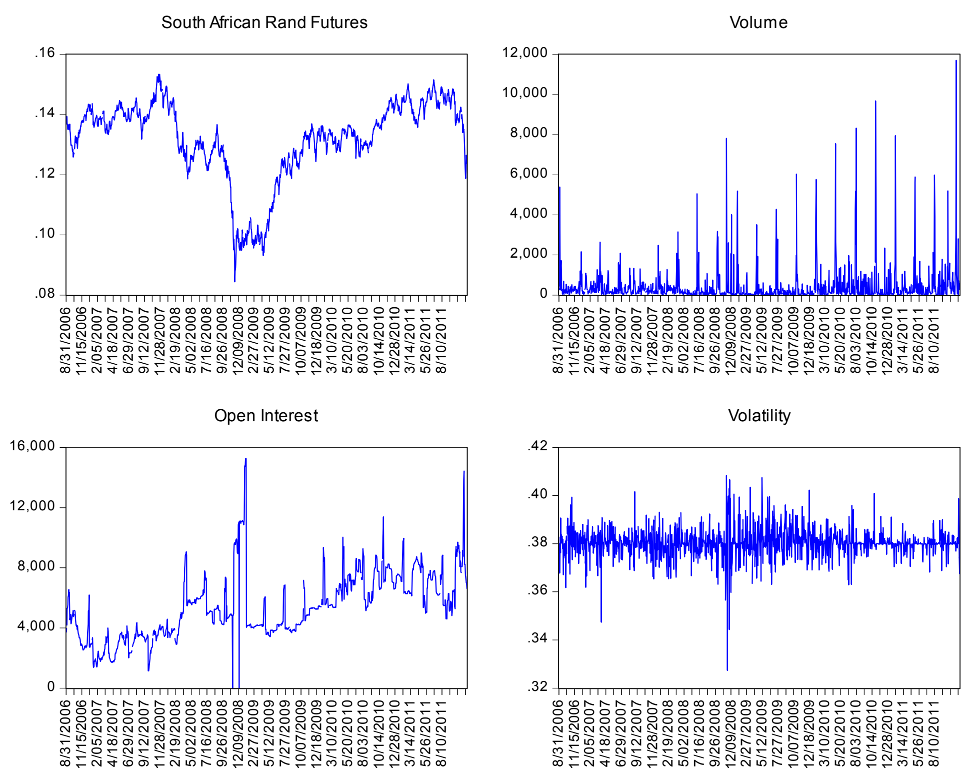

Figure 4. Time paths of currency futures price, trading volume, open interest and price volatility - South African Rand

Table 2. Contemporaneous correlations of futures trading volume, open interest and price volatility

	Volume	Open interest
Panel A: Brazilian Real		
Open interest	0.340***	
	(12.935)	
Volatility	0.264***	0.646***
	(9.783)	(30.259)
Panel B: Russian Ruble		
Open interest	0.510***	
	(21.219)	
Volatility	0.414***	0.741***
	(16.279)	(39.474)
Panel C: Chinese Renminbi		
Open interest	0.545***	
	(23.169)	
Volatility	0.521***	0.893***
	(21.783)	(70.675)
Panel D: South African Rand		
Open interest	0.479***	
	(19.531)	
Volatility	0.409***	0.927***
	(16.021)	(88.176)

The brackets ( ) report standard errors in parentheses; the asterisks *** represent the significance level at 1%.

3.3 Results of Markov switching model

We examine each of them separately with different generalizations of Hamilton's original switching-mean and constant-variance model augmented for instance in that we allow for unequal variance between the regimes or switching intercept.We use the three variables, two regimes, and two autoregressive lags MSVAR model to examine the relationship of futures trading volume, open interest and price volatility Tables 3 to 6 shows the results of the MSVAR models of the futures trading volume, open interest and volatility. To put it briefly, we make the conclusion that we can use the trading behaviors of hedgers to predict the trend of futures price volatility, and vice versa, we can apply the trend of futures price volatility to predict the hedgers' trading activity. In addition, we can use the trading behaviors of hedgers or speculators to help predict the other party's trading activity. The duration of regime 1 are much longer than the regime2. The trading volume has the largest variance for the four BRICS countries. The coefficients of lagged variables of trading volume and open interest significantly affected trading volume , open interest and volatility. The results show that the previous actions of hedgers and speculators affect the trading volume, open interest and volatility.

Table 3. The MSVAR model of futures trading volume, open interest and price volatility- **Brazilian Real**

Brazilian Real	Volume	Open interest	Volatility
Regime- dependent intercept			
constant1	4.108	3.446	0.376***
	(6.255)	(11.995)	(0.020)
constant2	6.148***	9.142***	0.378***
	(0.024)	(0.004)	(0.000)
Autoregressive parameters at lag 1			
Volume	-0.770***	-0.247***	0.001***
	(0.049)	(0.003)	(0.000)
Open interest	-0.227	1.753***	-0.004***
	(0.223)	(0.024)	(0.000)
Volatility	-6.104***	2.169***	-0.229***
	(0.475)	(0.011)	(0.079)
Covariance			
Volume	1.533***		
	(0.109)		
Open interest	0.022***	0.000***	
	(0.001)	(0.000)	
Volatility	0.004***	0.000***	0.000
	(0.000)	(0.000)	(0.000)
Duration			
Regime 1	0.363		
	(3.889)		
Regime 2	7.797***		
	(1.857)		
Transition probability	$\mathbf{P_{1i}}$	$\mathbf{P_{2i}}$	
Regime 1	0.841	0.159	
Regime 2	0.037	0.963	
ln L	**19.220**		
AIC	8.430		
SIC	8.448		

The brackets ( ) report standard errors in parentheses; the asterisks *** represent the significance level at 1%.

Table 4. The MSVAR model of futures trading volume, open interest and price volatility- **Russian Ruble**

	Volume	Open interest	Volatility
Regime- dependent intercept			
constant1	5.633	5.734	0.379***
	(9.375)	(9.691)	(0.010)
constant2	6.850***	10.874***	0.382***
	(0.017)	(0.027)	(0.000)
Autoregressive parameters at lag 1			
Volume	0.276***	-0.012***	0.000***
	(0.007)	(0.001)	(0.000)
Open interest	0.294***	0.989***	0.000
	(0.006)	(0.001)	(0.000)
Volatility	120.441***	5.346***	0.216
	(1.982)	(0.188)	(0.133)
Covariance			
Volume	0.101***		
	(0.002)		
Open interest	0.010***	0.001***	
	(0.000)	(0.000)	
Volatility	-0.001***	0.000***	0.000
	(0.000)	(0.000)	(0.000)
Duration			
Regime 1	0.856		
	(10.347)		
Regime 2	8.949***		
	(4.152)		
Transition probability	$\mathbf{P_{1i}}$	$\mathbf{P_{2i}}$	
Regime 1	0.632	0.368	
Regime 2	0.087	0.913	
ln L	**16.731**		
AIC	8.705		
SIC	8.725		

The brackets ( ) report standard errors in parentheses; the asterisks *** represent the significance level at 1%.

Table 5. The MSVAR model of futures trading volume, open interest and price volatility- **Chinese Renminbi**

	Volume	Open interest	Volatility
Regime- dependent intercept			
constant1	-5.960	6.622	0.380***
	(8.915)	(6.506)	(0.001)
constant2	2.940***	6.802***	0.380***
	(0.009)	(0.011)	(0.000)
Autoregressive parameters at lag 1			
Volume	1.947***	0.333***	-0.001***
	(0.017)	(0.001)	(0.000)
Open interest	1.401***	1.061***	0.000
	(0.011)	(0.002)	(0.000)
Volatility	0.000***	0.000***	-0.101
	(0.195)	(0.033)	(0.087)
Covariance			
Volume	0.004***		
	(0.000)		
Open interest	-0.002***	0.001***	
	(0.000)	(0.000)	
Volatility	0.000***	-0.002***	-0.153
	(0.000)	(0.000)	(0.000)
Duration			
Regime 1	-6.055		
	(4.224)		
Regime 2	-10.715		
	(3.353)		
Transition probability	$\mathbf{P_{1i}}$	$\mathbf{P_{2i}}$	
Regime 1	0.812	0.188	
Regime 2	0.061	0.939	
ln L	**22.480**		
AIC	**8.114**		
SIC	**8.134**		

The brackets ( ) report standard errors in parentheses; the asterisks *** represent the significance level at 1%.

Table 6. The MSVAR model of futures trading volume, open interest and price volatility- **South African Rand**

	Volume	Open interest	Volatility
Regime- dependent intercept			
constant1	3.889	9.223**	0.376***
	(4.113)	(4.165)	(0.015)
constant2	5.617***	9.399***	0.385***
	(0.270)	(0.124)	(0.005)
Autoregressive parameters at lag 1			
Volume	0.557***	0.047***	0.000
	(0.206)	(0.011)	(0.004)
Open interest	0.171***	0.961***	0.003***
	(0.015)	(0.003)	(0.000)
Volatility	-2.441***	-0.636***	0.160***
	(0.112)	(0.111)	(0.001)
Covariance			
Volume	0.944***		
	(0.027)		
Open interest	0.057***	0.005***	
	(0.000)	(0.000)	
Volatility	0.001***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)
Duration			
Regime 1	-0.578		
	(9.577)		
Regime 2	-4.109***		
	(0.118)		
Transition probability	$\mathbf{P}_{1i}$	$\mathbf{P}_{2i}$	
Regime 1	0.6754	0.3246	
Regime 2	0.1538	0.8462	
ln L	**12.027**		
AIC	**9.368**		
SIC	**9.385**		

The brackets ( ) report standard errors in parentheses; the asterisks *** , ** represent the significance level at 1% and 5%, respectively.

4. Discussion

The empirical findings of trading behaviors of currency futures of four members of the BRICS emerging countries include Brazilian Real, Russian Ruble, Chinese Renminbi and South African Rand are as follows. There is evidence indicates that speculators do destabilize the market by increasing trading volume in response to increased volatility on the first day because the relationship is positive. Hedgers help stabilize the market by decreasing their trading activity in response to increased volatility on the first day because the relationship is negative. In addition, speculators' demand for futures goes down in the beginning few days when futures price volatility increases, and hedgers on average demand fewer futures with the increased price volatility. The results are correspondent with the result from Bhargava and Malhotra (2007). Furthermore, the effect of trading behaviors of hedgers and speculators has the similar results each other, implying that trading activity of hedgers and speculators affect each other.

5. Conclusion

Using Markov-switching vector autoregressive analysis (MSVAR), this paper investigates the dynamic interactions among futures price volatility, trading volume, and open interest in the currency futures of four BRICS emerging countries. This article defines the daily futures trading volume as the trading activity of speculators, and the futures open interest as the trading activity of hedgers, and applying Garman-Klass volatility estimator to measure daily futures price variability.

The study will contribute to the literature in three perspectives. First, researchers mainly focus of these mentioned issues for agriculture and financial futures markets, very few do researches for emerging currenct futures markets. Second, prior literature usually investigates the issues mentioned individually. Therefore, this article connects the issues together to examine the interrelationship between the behaviors of trading activities and price volatility, and investigate how the time-to-maturity affects the behaviors of hedgers and speculators, and price volatility. Third, few of the previous articles study both the relationship between futures price volatility and trading volume and the relationship between futures price volatility and open interest. Our results also offer insights towards a better understanding about trading behaviors in currency futures. Finally, the investors wish to profit from arbitraging among different currency futures by taking advantage of the different trading information is processed and reflected in different currency markets.

Future research can explore the macroeconomic factors that drive the switching regime behavior of currency market returns and dynamic correlations. Expansions of wider sample markets may provide additional evidence on trading behaviors of currency futures and is a promising area for future work.

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