

The Methodology of the Relationship Study between Exchange Rate and Interest Rate in BRICs: Through UIP Channel

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Abstract—This paper aims to demonstrate the methodology to study the relationship between Exchange Rate and Interest Rate about BRICs. The purpose of this research is to investigate the application of the traditional UIP in BRICs countries. If the UIP does not work, the model could be tried to modify. The methodology includes the typical ADF test, cointegration test, VECM and Granger causality test. It will be useful to demonstrate the real relationship between exchange rate and interest rate in BRICs. And the BRICs can adjust the monetary policies based on the results.

Keywords—uncovered interest parity; BRICs; modify model; exchange rate

I. INTRODUCTION

Over the last 50 years, the world economy has changed dramatically with the process of financial liberalization and globalization. Especially, some developing countries have kept the faster progress than developed countries. O'Neill (2001) was the first one that brought out the idea of BRICs---a grouping acronym that refer to the countries of Brazil, Russia, India and China ^[1]. These countries are all the typical developing countries in the obvious economic grow. BRICs economies taken together could be larger than G6 and become the largest economy in the world in 21st century. South Africa officially became a member of BRICs in December 2012. Then, the BRICs have taken up over 40% of the world population, encompass nearly 25% of the world's land and owned 18.3% of the world nominal output.

Thus, the volatility of exchange rate in BRICs countries would associate with a significant influence on international trade. In Goldman Sachs's prediction, the exchange rate of the BRICs will go through a significantly upward trend. It can be believed that one third of the GDP growth of these countries may come from the attribution of currency appreciation. The BRICs could become a much larger force in the world economy based on the latest GDP growth, income per capital and currency movements. Furthermore, the gap between the BRICs and developed economies will slowly narrows down as the development occurs.

Each country of the BRICs has their own regime of the exchange rate. Brazil and South Africa have implemented the

floating exchange rate regime. And China, India and Russia are under the managed floating regime. In addition, these five counties all suffer the high inflation with the rapid development. Historically, many developing countries facing with the threat of more than 10 percent inflation rate to their economic growth. However, the monetary authorities of these developing countries continued to maintain pro-growth monetary policy for the goal of sustained growth. The traditional theories about the behavior of exchange rate might not suitable in the BRICs in the high inflation situation. The relationship between the exchange rate of the BRICs nations and their interest rate under the high inflation are meaningful to study due to the difference of their national conditions, degree of openness and their various policies choices.

This paper intends to discuss the methodology of relationship study between interest rate and exchange rate through UIP channel in the BRICs. Historically, UIP model always failed to perform well. Hence, the study tries to modify it to get a reasonable model for BRICs countries if traditional UIP fail.

II. ECONOMIC BACKGROUND OF THE BRICs

The emerging economies---Brazil, Russia, India and China---were all rank near the top in the list of the 20 leading economies of the world according to the basis of PPP and current prices at the end of 2000. The aggregate size of the BRICs was nearly 23.3% of the world GDP, which was higher than the European countries and Japan. These results showed the great impacts of the emerging market economies to the status of world economy. It means that these four counties---Brazil, China, India and Russia---have great potential in development.

There is no doubt that the advantages of geographic, population size and GDP dimension in the BRICs nations. The critical value and great potentiality of these economies are accepted by all researchers. Paula (2008) checked the GDP growth performance of the BRICs countries from 1990 to 2006; he found out that the economic performance and macroeconomic stability has diverged among these countries ^[2]. He made a study of analyzing the relationship between exchange rate regime, capital account convertibility and

economic performance in the BRICs countries since the beginning of the 1990s. The study stated that the BRICs countries have some crucial factors to their development, such as a gently and discreetly process of capital account liberalization. Their well-designed capital management techniques are consistent with the overall aims of the economic policy regime. The BRICs countries could handle speculative attacks on domestic currency because of the accumulation of exchange reserves owned by central bank. Besides, a managed floating exchange regime would keep the competitive and stable real exchange rate as an intermediate target of macroeconomic policy. Mallick and Sousa (2011) demonstrated the role of monetary policy in terms of inflation pressures in the BRICs emerging economies [3]. The empirical evidence illustrated that the monetary policies which focused growth rate were extremely inflationary before the 1990s. Even though the monetary authorities tried to target low inflation in the last decade, the impact of monetary policy in inflation has remained significantly because of the inflation persistence in these economies.

III. PREVIOUS RELEVANT STUDIES

There are series of researches relating to the exchange rate of the BRICs countries. The value of trade with developing countries has been growing three times faster than the developed countries. Among these, the BRICs are becoming dominant in international trade. They contributed to 60% in the trade value between developing countries. These facts have brought the attention on exchange rate volatility in BRICs. Maradiaga, Zapata and Pujula (2012) have displayed the test on the relationship between the effects of exchange rate volatility of the G-3 currencies on agricultural exports in each of the BRICs [4]. It could be found that exchange rate volatility in the G-3 countries has a significant effect on agricultural exports for China and Brazil, and no obvious impact on the other three countries. These results are just preliminary, and the authors demonstrated that the application of their own currencies in the pricing of their international trade might be good for the BRICs.

Tariffi (2012) estimated the short-term relationship between the real exchange rate, real macroeconomic variables and tariffs [5]. In his research, he detected that the currencies' values of the BRICs countries are all being positively affected by the reduced tariffs which is realized by the international negotiations at the WTO. Uncovered Interest Parity (UIP) is an ideal channel to employ in the BRICs in the purpose of detecting the relationship between exchange rate and interest rate. It is one of the cornerstone models in international finance and a critical building block in most theoretical models. The UIP condition always fail to hold empirically even though it is useful theoretically. Based on this widely belief, Chinn (2006) made a survey on some lately new findings about UIP when it faced the current float [6]. He re-evaluated the application of the standard UIP regressions in the contemporary world and re-examine the performance of UIP in long-term. Moreover, he tested the unbiasedness hypothesis in the case of emerging markets. It could be argued that the evidences against UIP in current floating rate are not seriously effect, even if the interest differential remains a biased predictor in the exchange rate in a short-run. Mehl and Capiello (2007) did a study on estimating

UIP at long horizons with emerging economies as an example [7]. Their estimation supported the idea that UIP hold better for exchange in dollar and other major mature economy currencies. However, it is not so good in emerging market economies. This might due to the political risk and the exchange rate premium. It could be believed that a standard Uncovered Interest Parity model is too restrictive, which means it does not count on some real variables' impact on exchange rate. The standard UIP model is modified into a UIP-plus-fundamentals model and examined its applicable in Brics.

IV. METHODOLOGY

Uncovered interest parity (UIP) condition presents the percentage change of expected future exchange rate which should be equal to the differential between the domestic and foreign bonds return rates with maturity in the same time horizon. The expected rate of depreciation of one currency against another currency, normally means the dollar, is equal to the interest rate differential between these two countries. Thus, UIP condition can be rewrite as

$$E\dot{S} = r - r^* \quad (1)$$

where $E\dot{S}$ represents the expected depreciation rate of the exchange rate of domestic currency, r is the domestic interest rate and r^* is the foreign interest rate. This equation indicated that the differential between r and r^* should equal to the expected depreciation or appreciation of the domestic currency.

The paper tends to test the relationship between exchange rate and interest rate in BRICs through UIP Channel. Firstly, the traditional model can be expressed as:

$$(i_t^* + 1)E_t(S_{t+\Delta})/S_t = (i_t + 1) \quad (2)$$

where:

S_t = price of foreign currency in units of domestic currency at time t

$E_t(\cdot)$ = represents the expectations operator conditional upon information available at t

i_t = return on a domestic asset at time t of maturity Δ

i_t^* = return on a comparable foreign asset

Thus, the previous literature could be followed and the logarithms in low-case letter could be denoted.

$$\begin{aligned} E_t(s_{t+\Delta} - s_t) &\approx i_{t,1} - i_{t,1}^* \\ \Rightarrow s_{t+1} - s_t &= \alpha + \beta(i_t - i_t^*) + \mu_{t+1} \end{aligned} \quad (3)$$

where s_{t+1} is the natural logarithm of S_{t+1} , which is expected exchange rate. And $s_t = \log(S_t)$ is the exchange rate, i_t is the domestic interest rate and i_t^* is the corresponding foreign interest rate. μ_{t+1} is mean-zero, serially uncorrelated random variables. Moreover, the differential of the interest rate

should be an unbiased predictor of future exchange rate changes.

Typical test for whether UIP theory hold needs two steps. The main purpose of this examination is focusing on the Ordinary Least Square (OLS) estimation of α and β in equation 3. The null hypothesis of UIP is $H_0: \alpha = 0$ and $\beta = 1$. The problem with using OLS as an estimation tool involves to the issue of non-stationary of the time series. If the time series data were non-stationary, then the estimate β would be spurious and biased. In that case, it could be proved that the variables are cointegrated, so the OLS estimate results could be consistent and converge to their true value. Therefore, first step might be run the Augmented Dickey-Fuller (ADF) test for unit root. If the variables are integrated of the same order, they can be tested for cointegration relationship. Secondly, regress the equation and estimate α and β , also with the error term. If the regression outputs match the null hypothesis or close to the number, then the UIP works in the case of BRICs. If the estimate coefficients are far from 0 and 1, and the critical value for the T-statistic and F-statistics are not significant, then the model is not suitable.

Under the circumstance of examining UIP in the BRICs emerging economies, some special variables must be taken. To bring the model closer to reality, the assumption of equal riskiness in domestic and foreign asset is relaxed.

At the same time, each country's inflation has different tendency. The effect of inflation is hard to detect. Thereby, for notational simplicity, the factor of inflation should be eliminated. The real interest rate can be employed to instead of the nominal interest rate. Calculate the real interest rate based on the Fisher equation

$$i \approx r + \pi \quad (4)$$

where i represents the nominal interest rate, r is the real exchange rate and π is the inflation rate. The real interest rate could be used to instead of nominal interest rate and estimate the coefficients of the following regression again:

$$s_{t+1} - s_t = \alpha + \beta(r_t - r_t^*) + \mu_{t+1} \quad (5)$$

If the output still out of place, then it can be told that the traditional UIP model performs badly in the case of BRICs. It is time to modify the traditional UIP model. Because the BRICs countries have different exchange rate regimes to adjust to the market's changes, it is difficult to take each countries' differential exchange rate into account. Besides, UIP has been found fail to forecast future exchange rate. And interest rate differentials do not explain very well about the future variation in exchange rates in many empirical tests. The left side of equation 5 is Δs_t , which indicates the depreciation or appreciation of the exchange rate from time t to $t+1$. Hence, if the standard UIP failed, it is possible that the Δs_t , along with the differential of interest rate between domestic and foreign country would affect exchange rate in the future. Thus, equation 5 can be modified as followed.

$$s_{t+n} = \alpha + \theta \Delta s_t + \beta(r_t - r_t^*) + \mu_{t+1} \quad (6)$$

Therefore, the modified model can be expressed as (7).

$$s_{t+n} = \alpha + \theta \Delta s_t + \beta_1 r_t - \beta_2 r_t^* + \mu_t \quad (n \geq 2) \quad (7)$$

In the practical examination of (7), the real interest rate could be used to instead of nominal interest rate to ignore the influences of high inflation rates in these countries. Granger Causality test should be applied for these two countries to find out whether the differential of current exchange rate along with real interest rate could affect exchange rate in one month and in three months. The US interest rate will be the foreign interest rate in the follow up tests.

Johansen cointegration technique is explored for more than one cointegration relationship. If the results come out the variables are cointegrated, then the coefficients of the linear combination are super consistent. Equation (7) should be regressed to see if the variables are significant in both t-test and F-test. If the results reveal that they are significant, then it could be told that the modified model can be used for detecting the relationship between exchange rate and interest rate in BRICs.

Afterwards, the Vector error-correction model (VECM) should display for testing short-term effect on long-term relationship. This can only be done after the cointegration test. At last, do the Granger Causality test for the purpose of discovering if each variable have granger cause with exchange rate. If the P-value is less than significant level of 0.05, we can reject the null hypothesis of non-existing Granger causality relationship and say one variable granger cause another variable. If the P-value is over the significant level, it could be told that there has been no granger causality relationship. In this study, the above processes would be applied to each five countries.

V. CONCLUSION

This paper analysis the relationship between exchange rate and interest rate in the BRICs through the UIP channel. It is not surprisingly that traditional UIP do not work. Thus, modified the standard model based on an explanation why UIP fail. Furthermore, confronting the fact that these five countries all suffered high inflation rate, the modified model use real interest rate instead of nominal interest rate. As for the BRICs countries have different exchange rate regimes, the modified model is less restrictive than a standard UIP model. The practical outcomes of the modified model will demonstrate the real relationships between the BRICS. If the result from the test is useful, the methodology of this paper can be used to offer some advices for monetary policies adjustment.

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