Covered Interest Rate Parity Among BRIC Nations

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Abstract

For this study, we used the covered interest rate parity (CIRP) relation to examine the extent to which the liberalization of Brazil's, Russia's, India's, and China's (BRIC) financial markets have resulted in the integration of BRIC countries' currency markets into the global financial markets. We tested for the interest rate parity market equilibrium condition between March 2004 and September 2008. Further, to estimate the economic significance, we also constructed a forward hedge portfolio to assess the degree of arbitrage possible during the period of study. Results suggested that profitable arbitrage opportunities do exist; however, these might be limited due to transaction costs, or regulatory, political, or other constraints. Our findings also indicate that currency markets of BRIC countries exhibit varying degrees of interest rate parity efficiency over the period of this study.

Keywords: Interest rate parity, financial integration, BRIC
JEL Classifications: F31/F36

Introduction

Among the fundamental tests of international finance is the Covered Interest Parity (CIRP) theorem, which states that the exchange rate forward premiums (discounts) are offset by the respective interest rate differential between two currencies. A related theorem is the uncovered interest rate parity (UIP), which states that the return on an uncovered foreign currency deposit should be equal to the return on an equivalent domestic deposit regardless of the national market within which the foreign deposit is located. In contrast, CIRP holds that interest rate differentials between two countries are offset by the spot/forward currency premiums. A violation of this relationship indicates an arbitrage opportunity (for instance, see Frankel, 1992, 1993; and Montiel, 1993).

The bulk of empirical work on the issue of CIRP is limited to the developed economies. Capital markets outside the developed nations largely have been ignored, whereas interest in the issue of liberalization and integration of capital markets of emerging economies, has focused largely on equity markets, while ignoring currency markets[1]. Recently, many studies have used CIRP to examine integration of the currency markets of emerging markets into global capital markets. For example, Pasricha (2007) analyzed the efficiency of currency and short-term capital markets and the level of integration of emerging market economies into the world economy. Pasricha used deviations from CIRP during the last 10 years to evaluate currency market efficiency for emerging markets. Similarly, Adrangi, Allender, and Raffiee (2003) tested for the interest rate parity condition for Chilean and Mexican currency markets. Francis, Hasan, and Hunter (2002) examined uncovered interest rate parity for Colombia, Mexico, India, Korea, Malaysia, Pakistan, Thailand, and Turkey in order to examine the integration of their currency markets into the global economy. Skinner (2008) also tested for CIRP for emerging markets of Brazil, Chile, Russia, and South Korea and concluded that the CIRP condition does not hold for longer time periods.

This study extended the understanding of the integration of the currency market of the emerging market nations by examining the issue of CIRP for the case of BRIC nations (Brazil, Russia, India, and Brazil). Several factors inspired this investigation. First is the implication of interest rate parity for market efficiency (e.g., Frankel, 1992; Levich, 1979). In an efficient market, optimal allocation of resources (Fama, 1970, 1976), ideally should keep agents from earning abnormal profits due to the interest rate and exchange rate differential, because these will be priced appropriately to reflect all the available information. The test for market efficiency then should reject any claims for abnormal arbitrage situations that may arise out of forward premium rate deviation beyond the transaction costs from those implied yet by covered interest rate parity (Thornton, 1989). Such factors have not been investigated for the currency markets of BRIC nations. Second is establishing and testing the exchange rate determination policies of the BRIC nations' post liberalization period (e.g., Mussa, 1985). Results from this study provide meaningful managerial implications, which are important for policy makers and currency market practitioners[2]. If the liberalization process of BRIC economies has led to the integration of their currency markets into the world capital market, then this integration can have implications from the viewpoint of uninhibited capital flow and international trade across the borders.

BRIC nations represent some of the fastest growing economies of the world and have been projected to surpass the current wealthiest countries in the next 50 years. To attract foreign direct investment (FDI), a rational approach of the monetary authorities of these and other emerging market countries would be to integrate their financial markets rapidly with the global economies. If the financial market liberalization process in these nations has been successful in integrating their market into the pool of world markets, then a foreign investor will not demand a risk-premium in the returns on deposits in these markets (Francis et al., 2002). From a macroeconomic viewpoint, an understanding of the degree of financial integration is important, because it will impact the free flow of capital in and out of these economies. The financial integration will bring enhanced liquidity and promote market efficiency by facilitating the smooth transfer of funds between borrowers and lenders that will promote capital mobility among nations. If the Interest Rate Parity (IRP) equilibrium condition does not hold, capital markets may not be efficient; therefore, opportunities for money managers, hedge funds, and other speculators to exploit market misalignments for profit may exist (Adrangi, et al., 2003). As long as the IRP is not in the equilibrium, arbitragers will conduct CIRP arbitrage as long as the interest rate differential is more than the spot-forward differential. Hence, it is important that the convergence issue of the CIRP condition among BRIC nation is tested empirically.

Econometric Methodology

CIRP equilibrium condition is a direct consequence of CIRP arbitrage. According to Thornton (1989), in the absence of transaction costs, the CIRP condition holds if:

$$\ln(1+i_t) - \ln(1+i_t^*) - \ln(f_t) + \ln(S_t) = 0 \quad (1)$$

Where at a given time (t), (i) and (i^*) are the domestic and foreign interest rates respectively, and (f) and (s) are the forward and spot rate (foreign currency unit in domestic currency terms). The foreign and domestic investments are assumed equivalent and identical except for the currency in which these are held. If equation (1) does not hold, then there will be riskless profit opportunity available for arbitragers. Barring any entry costs or transaction costs, one may borrow one of the currencies and sell it in the spot market for the other currency, which then is loaned and bought

back in the original currency in the forward market. Such arbitrage should continue, theoretically, to influence changes in interest rate and exchange rate until equation 1 holds in a fully efficient market (Taylor, 1987).

Consequently, we can formally state an arbitrage equilibrium condition, where there is no arbitrage possible:

$$(2) \qquad (1+i_t) = \frac{f_t}{S_t}(1+i_t^*)$$

Alternatively, no arbitrage equation can be restated as:

$$(3) \qquad (f_t) = S_t\left[\frac{1+i_t}{1+i_t^*}\right]$$

From equation 2, we can assert that a linear combination of the interest rate(s), forward rate, and spot rate is zero in the absence of transaction costs, represented by the following model:

$$(4) \qquad (f_t) = \alpha + \beta_1\left(S_t\left[\frac{1+i_t}{1+i_t^*}\right]\right) + \xi_t$$

A linear combination (regression test) of equation 4 in a time horizon should yield $\alpha = 0$ and $\beta_1 = 1$, which suggests evidence for covered interest rate parity. A deviation from the equilibrium condition implies that arbitrage situation exits.

Next, we constructed arbitrage (hedging) portfolios for the sample time period. Under the assumption of no transaction cost, we considered the following hedging transaction: borrow domestically, lend in a foreign country, and sell the receivable forward in a foreign country to reach the following net cash flow specified in equation 5:

$$(5) \qquad \left[(1+i_t^*)f_t\right] - \left[(1+i_t)S_t\right]$$

Under CIRP condition, equation 5 should be the market equilibrium condition and generate no deviations from zero. The portfolio assumes that we borrow at one interest rate and simultaneously lend at another interest rate, with the exchange rate risk fully covered through forward hedging. When equation 5 holds, currency market participants shall be indifferent between investing in domestic country or foreign country with forward hedging. However, if the CIRP condition is violated, investors will prefer one over the other.

The Data

In order to estimate any deviation from CIRP, it was important to have data on the appropriate exchange rates and interest rates recorded at almost the same instant in time at which an arbitrager could have engaged in a transaction (Taylor, 1987). Moreover, to avoid a bias in the data due to local political or other significant variables, considering only the period(s) without major structural changes was important for the study.

In assessing these issues, we selected relevant daily data from March 29, 2004, and September 1, 2008. The source of these data was the Thomson Financials Datastream database. Rate control on Certificates of Deposits (CDs) and commercial papers were removed in BRIC countries during the middle and later half of the 1990s, and major interest rate liberalizations followed in 1994 and 1995. Similarly, the exchange rate liberalizations were implemented during the same time-period (Francis, 2002). Also, in terms of sample time period for this study, we evaluated the parity conditions after a turbulent period that followed liberalization in BRIC nations, which was characterized by substantial foreign investment and an almost unrestricted inflow and outflow of capital. Hence, the period was appropriate for the tests. The reference nation for our study was the U.S., which is a principal trading partner of the BRIC nations. High levels of trade between the U.S. and BRIC nations ensured demand and exchange of currencies between the U.S. and the BRIC nations, which served as a good benchmark to test the CIRP condition.

Brazil/U.S. (BRASPT), Russia/U.S. (RUSSPT), India/U.S. (INDSPT) and China/U.S. (CHISPT) were the variables used for the spot rates. Brazil/U.S. 3 month forward (BRA3MF), Russia/U.S. 3 month forward (RUS3MF), India/U.S. 3 month forward (IND3MF), and China/U.S. 3 month forward (CHI3MF) were the variables for the forward rates. Proxies for interest rates are the annualized values for Brazil (BRA3FI), Russia (RUS3MI), India (IND3MI), China (CHI3MI), and U.S. (US3MI). Consistent with previous studies, we selected default-free interest instruments. Table 1 provides the summary statistics of the data used in this study.

Table 1: *Descriptive Statistics*

	Mean	Median	Standard Deviation	Sample Variance	Kurtosis	Skewness
BRASPT	2.2373	2.1637	0.4186	0.1753	-0.6243	0.4670
RUSSPT	26.8647	27.0033	1.7780	3.1611	-0.9879	-0.4649
INDSPT	43.6710	44.0300	2.1719	4.7173	-0.7830	-0.6056
CHISPT	7.8449	8.0023	0.4400	0.1936	-0.2778	-0.9145
BRA3MF	2.2954	2.2054	0.4476	0.2004	-0.6757	0.4845
RUS3MF	26.9125	26.9727	1.8062	3.2624	-1.0429	-0.3176
IND3MF	43.7365	44.0282	2.1464	4.6072	-0.6800	-0.6631
CHI3MF	7.7521	7.9216	0.4589	0.2106	-0.4251	-0.8689
BRA3MI	14.1685	13.7400	3.2303	10.4350	-1.2317	0.2199
RUS3MI	5.8716	5.6725	0.9956	0.9912	0.9750	0.9881
IND3MI	6.1586	6.3000	1.1393	1.2981	-0.5371	0.2655
CHI3MI	5.6160	5.4000	0.5474	0.2996	-0.8854	0.8143
US3MI	3.2909	3.4100	1.3595	1.8482	-1.4043	-0.2128

Note. Descriptive statistics are for the BRIC countries and the U.S. Variables in the table include: Brazil spot rate (BRASPT), Russia spot rate (RUSSPT), India spot rate (INDSPT), China spot rate (CHISPT), Brazil 3 month forward rate (BRA3MF), Russia 3 month forward rate (RUS3MF), India 3 month forward rate (IND3MF), China 3 month forward rate (CHI3MF), Brazil 3 month interest rate (BRA3MI), Russia 3 month interest rate (RUS3MI), India 3 month interest rate (IND3MI), China 3 month interest rate (CHI3MI), and U.S. 3 month interest rate (US3MI).

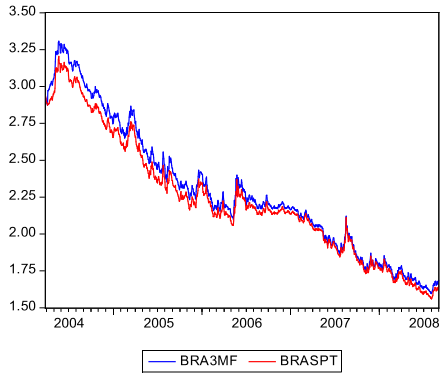

Figure 1a: Brazil spot rate (BRASPT), 3 month forward rate (BRA3MF)

Figures 1a, 1b, 1c and 1d graph the observed spot and 3-month forward rates (with respect to the U.S. dollar) for currencies of Brazil, Russia, India, and China, respectively.

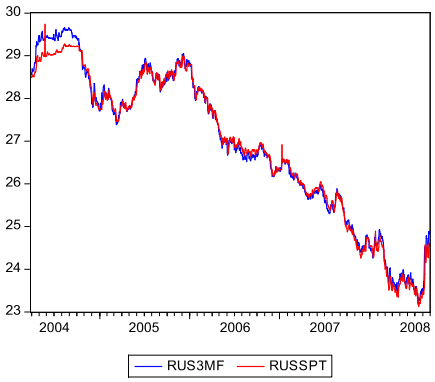

Figure 1b: Russia spot rate (RUSSPT), 3 month forward rate (RUS3MF)

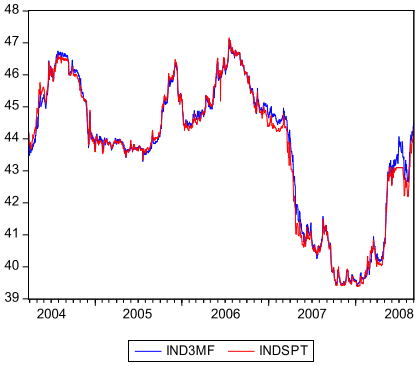

Figure 1c: India spot rate (INDSPT), 3 month forward rate (IND3MF)

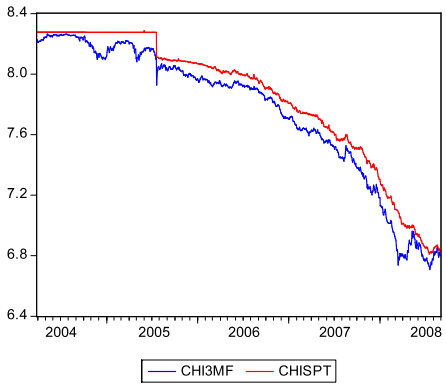

Figure 1d: China spot rate (CHISPT), 3 month forward rate (CHI3MF)

With respect to 3-month interest rate, Brazil's interest rates, on an average, seem to be higher compared to other countries in our sample. In addition, the range between the minimum and maximum for Brazil is more, compared to other countries in sample. This observation was consistent with the fact that the Brazil Central Bank (BCB) was compelled to increase the interest rate in order to seek to reduce the "pass through effect" (Fernando de Paula, 2007). Interest rates for other countries were in a narrower range.

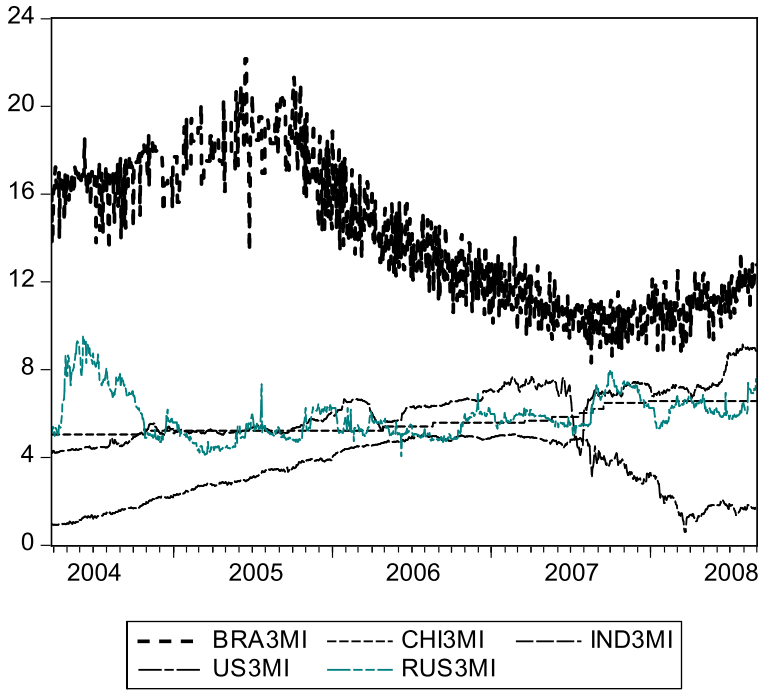

Figure 2: 3-month interest rate – Brazil (BRA3MI), Russia (RUS3MI), India (IND3MI), China (CHI3MI) and the U.S. (US3MI)

Empirical Results

Results for equation 4 are presented in Table 2. A linear combination of equation 4 in a time horizon should yield $\alpha = 0$ and $\beta_1 = 1$, which suggests evidence of CIRP equilibrium. Clearly, this was not evident for all countries in our sample. The empirical evidence presented a weak relation contrary to the CIRP, which tended to force a relationship between forward rate premiums and interest rate differentials. Theoretically, this discrepancy can trigger arbitrage, which, in the long run, should eliminate any arbitrage discrepancy. In an efficient market and globally integrated economy, the market forces cause the forward rate to differ from the spot rate by an amount that is sufficient to offset the interest rate differential between the two currencies. However, in the case of Brazil, Russia, India, and China, there was no evidence of interest rate parity condition holding in a linear time frame term during the sample period.

Table 2: *Results for Equation 4*

	Brazil	Russia	India	China
α	-0.001***	0.000***	0.000***	-0.011***
$\beta 1$	1.006***	1.014***	1.021***	1.102***
	[7.994]	[8.340]	[7.580]	[26.832]

The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels respectively. In parenthesis are t-statistics.

Note. $(f_t) = \alpha + \beta_1 \left(S_t \left[\frac{1+i_t}{1+i_t*} \right] \right) + \xi_t$ Where at a given time (t), (i) and (i*) are the domestic (Brazil, Russia, India and China) and foreign (U.S.) interest rates respectively, and (f) and (s) are the forward and spot rate (foreign currency unit in domestic currency terms). A linear combination of equation 4 in a time horizon should yield $\alpha = 0$ and $\beta_1 = 1$, suggesting evidence for covered interest rate parity. A deviation from the equilibrium condition implies that arbitrage situation exits.

Market returns (capital or currency markets) of the emerging countries with their characteristics of higher sample averages, low correlations with developed market returns, and higher volatility (Bekaert & Harvey, 1997) often have proved to be a challenge when existing finance models were applied to them (e.g., world version of CAPM). These models work with some success when applied to developed market returns (Harvey, 1991) and fail when applied to emerging market returns (Harvey, 1995). This notion informed the current study where the deviations from interest rate parity in emerging markets were likely to be larger and more persistent than developed markets because of the structural changes in the process of liberalization and global economic integration.

Three countries in our study, Russia, India, and China, until recently have remained relatively closed economies. Not until the 1990s were direct and indirect investments by foreign nationals and institutional investors allowed in equity markets of these countries. Investment potential was never reached due to counter-productive tax rates, managed currency policies, customs duties, and a general protectionist approach that kept these economies—as well as the stock market —relatively closed to foreign investment. Default risk and country risk also have been used to explain deviation from the IRP condition, which may explain the deviation in our study. The results were consistent with past research, with Brazil, Russia, India, and China, as emerging markets, empirically exhibiting deviation from interest rate parity equilibrium.

Table 3 presents results of the arbitrage equilibrium condition, specifically the number of times condition $(f_t) > (S_t)\left[\frac{1+i_t}{1+i_t*}\right]$ exists. We found that for Brazil, Russia, India, and China, the condition was 820, 1060, 1045, and 1156 times, respectively. Further, the forward rate represents the market expectations concerning the forward rates for these currencies. The unbiased forward rate hypothesis posits that the forward rate fully reflects all available information about the forward rate expectations (Cornell, 1977).

Table 3*: Results for Arbitrage Equilibrium*

Country	Number of Times Observed Forward Rate > Parity Forward Rate
Brazil	820
Russia	1060
India	1045
China	1156

Note. Number of time condition $(f_t) > (S_t)\left[\frac{1+i_t}{1+i_t*}\right]$ exists. Where at a given time (t), (i) and (i*) are the domestic (Brazil, Russia, India, and China) and foreign (U.S.) interest rates respectively, and (f) and (s) are the forward and spot rate (foreign currency unit in domestic currency terms). If interest rate parity condition holds, $(f_t) > (S_t)\left[\frac{1+i_t}{1+i_t*}\right]$ should not exist. If it does, then the condition implies that arbitrage situation exits.

To make economic relevance for our results from Table 3, we constructed a hedging portfolio based on equation 5 to confirm the value of the interest rate arbitrage. Assuming no transaction cost and using an *always hedge* strategy, we constructed a riskless portfolio for each BRIC country (since we were invested in almost risk free securities). The portfolio assumed that we borrowed at one interest rate and simultaneously lent at another interest rate, with the exchange rate risk fully covered through forward hedging. Results for our portfolios are presented in Table 4. For the sample period, we found the following annualized returns: Brazil (1.550%), Russia (2.019%), India (2.509%), and China (7.267%). Under covered interest parity conditions there should be a zero cash flow, that is, the condition of being no different between investing money in Brazil, Russia, India, China, or the U.S.

Table 4: *Results for Covered Interest Rate Parity Arbitrage Portfolio*

Country	Percent Profit From Arbitrage Portfolio
Brazil	1.550%
Russia	2.019%
India	2.509%
China	7.267%

Note. Under the assumption of no transaction cost, percent profit for following hedging transaction: borrow domestically, lend in foreign country, and sell the receivable forward in foreign country to reach the following net cash flow: $\left[(1+i_t*)f_t\right]-\left[(1+i_t)S_t\right]$

The deviations have to be interpreted carefully because they do not imply that CIR arbitrage is always practically possible. There are several factors to consider, such as the characteristics of foreign investments, repatriation of profits, transaction costs (regulation of international currency transactions), and political risk. For the most part, providing a premium for investing in domestic currencies of the BRIC countries is necessary. Another explanation for deviations from CIRP may be the presence of home bias. According to Kho, Sturtz, and Warnock (2006), somewhat poor corporate governance in some countries, such as the sample of the BRIC nations, makes it optimal for insiders to own large stakes in firms in that country, which impedes foreign investors. Therefore, capital mobility is restricted, and, hence, arbitrage opportunities continue to exist with respect to exchange rate and interest rate.

An important question is how long will the arbitrage last? Theoretically, it should only last for a short while. As soon as deviation from market equilibrium is detected, market agents will immediately carry out the covered interest arbitrage. Because of the arbitrage, the interest rate parity condition should be restored. However, the real economic benefit might be limited due to transaction costs and capital controls. Our study assumed no transaction cost; however, in the real world, transaction costs do exist in the form of a bid-ask spread in the interest rate (borrowing-lending) as well as foreign exchange market (bid-ask), and these will limit or completely eliminate the profit potential through arbitrage.

Summary and Conclusions

Emerging markets provide a challenge to international exchange rate economic relationships in terms of consistency. However, understanding the deviations does provide an insight toward the fundamental assumptions of these relationships and why they exist in the first place. Such analysis also helps in our understanding of the global integration process of the financial markets of these countries and, more importantly, the degree of integration.

In this study, we investigated IRP relations for the emerging markets of Brazil, Russia, India, and China with their major trading partner, the United States of America. We tested whether the CIRP holds for the emerging market of the BRIC countries. The empirical analysis for interest rate parity for these countries was set-up with the U.S., as the major trading partner of the BRIC countries.

Results from the data between the period of March 2004 and September 2008 suggest that CIRP (market equilibrium condition) does not hold. Several noteworthy conclusions can be derived from our results. First, profitable arbitrage opportunities seemed to exist, at least theoretically, during the period of our study. However, this arbitrage might be limited due to presence of regulatory or political restrictions and other constraints, such as transaction costs, borrowing constraints, or political risks. Also, in view of the recent time line of the major liberalization policy in BRIC nations and as this liberalization effect sets in, the arbitrage opportunity could further diminish, signaling that BRIC nation's currency markets were showing signs of increased efficiency of their financial markets.

Endnotes

1. For detailed literature review see, Bekaert (1995), Bekaert and Harvey (1995), Korajczyk (1996), and Hunter (2002).
2. An understanding of results of covered interest arbitrage from our study will also help international currency traders who are interested in the BRIC countries in formulating

their strategies to borrow in one currency (*funding currency*) and lending in another currency (*target currency)*.

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