Deviation from Covered Interest Parity and the Influence of Arbitragers and Speculators in Asian Currency Markets

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Abstract: - Covered interest parity occurs when the no-arbitrage condition is satisfied with the use of a foreign exchange forward contract to hedge against exposure to foreign exchange rate risk when interest rate parity is covered. Agents in the foreign exchange market will be indifferent to the available interest rates in the two currencies because the forward exchange rate achieves equilibrium, thereby eliminating the potential to realize covered interest arbitrage profits. Covered interest rate parity holds when there is open capital mobility. In this paper we identify deviation from covered interest parity that incorporates the onshore and offshore foreign exchange forward market of Emerging Asia. The model is able to identify the behavioural pattern of arbitragers and speculators in foreign exchange forward markets. This exercise provides fresh insights for central banks and financial regulators in managing capital mobility in a prudent and effective manner.

Key-Words: - Capital Mobility Covered Interest Parity Model, Arbitragers, Speculators, Onshore and Offshore Foreign Exchange Forward Market, Arbitrage Profit and Loss, Emerging Asia.

1 Introduction

In Emerging Asia (EA) following the Asian Financial Crisis of 1997/1998, managing capital mobility is a key feature for central banks and financial regulators. The imposition of rules and regulations to capital mobility is part of Emerging Asia's macroeconomic policy framework. The uncertainty of these rules and regulation being imposed strictly or relaxed in managing capital flow created a parallel foreign exchange market beyond the regulatory parameters of central banks and financial regulators of Emerging Asia (EA). The creation of a segmented foreign exchange markets that consists of onshore and offshore is a result of these rules and regulations. The offshore foreign exchange market relies on the non-deliverable foreign exchange forward while the onshore foreign exchange market relies on the deliverable foreign exchange forward. In the context of offshore foreign exchange trading, the non-deliverable foreign exchange forward rate features as a significant foreign exchange trading instrument that circumvents barriers to capital mobility in Emerging Asia (EA). The instrument's attractiveness include the ability to settle foreign exchange trading transactions in US Dollar and does not require foreign investors to have an underlying financial trading asset in the onshore market.

In our paper, we choose to model the foreign exchange forward markets in Emerging Asia (EA) by incorporating the onshore and offshore foreign exchange forward rate into the covered interest rate parity (CIP) model[1]. The approach we use is by re-specifying the original covered interest parity (CIP) equation into a more simplified specification that enables us to obtain a CIP equation that is adoptable for foreign exchange forward markets of Emerging Asia (EA). In order to measure the excess demand function for arbitragers and speculators and the magnitude of arbitragers and speculators influence in the foreign exchange forward market, we model the behavior of arbitragers and speculators. These two aspects, an CIP model that is adoptable to EA foreign exchange forward markets and the modeling

[1] When the no-arbitrage condition is satisfied with the use of a forward contract to hedge against exposure to exchange rate risk, interest rate parity is said to be covered. Investors will still be indifferent among the available interest rates in two countries because the forward exchange rate sustains equilibrium such that the dollar return on dollar deposits is equal to the dollar return on foreign deposit, thereby eliminating the potential for covered interest arbitrage profits.

of arbitragers and speculators behavior within the framework of a EA CIP model, is expected to provide fresh insights for central banks and financial regulators in managing capital mobility in a prudent and effective manner.

Data used in this analysis is daily time series from 2nd June 2008 to 30th September 2011 for four Emerging Asia currencies, namely, Indian Rupee (INR), South Korean Won (KRW), Indonesia Rupiah (IDR) and Malaysian Ringgit (MYR)

2 Problem Formulation

2.1 Deviation from Covered Interest Parity

The covered interest parity model incorporates four important components. These include the forward exchange rate, spot exchange rate, domestic interest rate and foreign interest rate, computed as

$$F = S\frac{1+i}{1+i^*} \qquad (1)$$

Where F is the forward exchange rate in the onshore foreign exchange market and in the offshore foreign exchange market, it is substituted with the non-deliverable forward exchange rate. S is the spot exchange rate of EA currency against the US Dollar, i is the onshore interest rate which is substituted by the implied yield derived from the forward exchange rate[2] in the onshore foreign exchange market, and as the implied yield derived from the non-deliverable forward exchange rate in the offshore foreign exchange market. The foreign interest rate i^* is the US Dollar London Interbank Offered interest rates (Libor), alternatively it is the proxy for cost of funding foreign exchange trading. The equilibrium condition from equation (1) indicates that gross domestic return is equal to gross covered foreign return at the forward exchange rate. It is gross because it includes the amount invested and the interest earned. The gross foreign return is covered because the foreign return is converted into the domestic currency at the forward exchange rate hence the covering of foreign exchange risk. The interchangeably of equation (1) can be specified in different forms as well, where further computation show

$$(1+i) = \frac{F}{S}(1+i^*) \qquad (2)$$

The specification of equation (2) is still consistent with covered interest parity but provides the ability to distinguish between the actual forward exchange rate F which prevails whether or not covered interest parity holds and the equilibrium forward exchange rate $\dot{F}$, which can be considered as the no arbitrage condition foreign exchange forward rate. Therefore the covered interest parity equilibrium condition can be re-written as $\dot{F}=F$. Whereby

$$\dot{F} = S\left(\frac{1+i}{1+i^*}\right) \qquad (3)$$

From equation (3), the specification shows that there is equality between the equilibrium forward exchange rate $\dot{F}$ and the actual forward exchange rate F, thus can be expressed as

$$i = \left[\frac{F}{S}(1+i^*)\right] - 1 \qquad (4)$$

The derivation of equation (4) indicates i as the implied yield derived from the forward exchange rate in the onshore foreign exchange market, where else in the offshore foreign exchange market, the implied yield is derived from the non-deliverable forward exchange rate. The spread between the equilibrium forward exchange rate and the actual forward exchange rate is the forward gap which is denoted as $f = \dot{F} - F$. The spread is measured as the difference between the implied yield derived from the forward exchange rate in the onshore foreign exchange forward market and the implied yield derived from the non-deliverable forward rate in the offshore foreign exchange forward market.

The foreign interest rate, the US Dollar Libor and the difference against the implied yield derived from the foreign exchange forward rate can be considered as the carry return (which in the original form is also specified as the interest rate differential) and denoted as $i - i^*$. Therefore it can be written that

$$\dot{F} - F = i - i^* \qquad (5)$$

Where equation (5) implies that in order for covered interest parity to be achieved, the condition $\dot{F} - F = i - i^*$ must be fulfilled, which further suggest that the

[2] Where the implied yield is $i = \left[\frac{F}{S}(1+i^*)\right] - 1$, which is computed for the onshore foreign exchange forward market. In the offshore foreign exchange forward market, the computation is the same but the forward exchange rate is substituted with the non deliverable forward rate. The implied yield that is obtained from the computation provides two different implied yield based on the onshore and offshore foreign exchange forward market.

forward gap is equivalent to the carry return. Under conditions of $i - i^* > \dot{F} - F$, agents in the foreign exchange forward market would sell EA currencies to achieve covered interest parity equilibrium. Under conditions of $i - i^* < \dot{F} - F$, agents in the foreign exchange forward market would buy EA currencies to achieve covered interest parity equilibrium (see Figure 1).

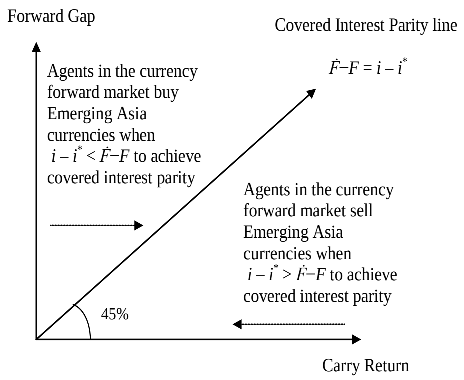

Figure 1. Covered Interest Parity and Adjustments towards Equilibrium

In estimating whether there is an occurrence of covered interest parity, based on the interchangeably of the original covered interest parity equation (1) to (5), we can formulate the equation for estimation purposes as

$$\dot{F} - F = a + b\left[\frac{F}{S}(1 + i^*)\right] - 1\,) - i^* + \varepsilon_t \quad (6)$$

Equation (6) indicates that the difference between the equilibrium forward exchange rate and actual forward exchange rate, which is $\dot{F} - F$, is determined by the carry return given by the difference between implied yield derived from the forward exchange rate and the foreign interest rate, which is

$$\left[\frac{F}{S}(1 + i^*)\right] - 1\,) - i^*.$$

The constant and error term is denoted as a. and ε_t while b is the coefficient that measures the covered interest parity. Where

$$b = i = \left[\frac{F}{S}(1 + i^*)\right] - 1 \quad (7)$$

Equation (7) is the covered interest parity model in the context of incorporating the onshore and offshore foreign exchange forward market of Emerging Asia. If there is an occurrence of covered interest parity, the $b = 0$, while deviation from covered interest parity will indicate the $b \neq 0$.

2.2. Modeling the Behavior of Arbitragers and Speculators

Arbitrage involves the simultaneous buying and selling of a financial asset in order to profit from small difference in prices. Financial market inefficiencies and pricing mismatches are exploited by arbitragers. Since arbitrage involves the simultaneous buying and selling of a financial asset, it can be construed as a type of financial hedge that involves limited risk. In the case of speculation, it involves the trading of financial assets or conducting a financial transaction that has a significant risk of either losing all of the initial outlay on expectations of a substantial gain. The risk of loss is more than offset by the possibility of making huge gains. Speculators take calculated risk and are not dependent on pure chance. To identify the influence of arbitragers and speculators in the foreign exchange forward market, it is pertinent to model the excess demand for foreign exchange forwards. The excess demand function is further integrated to identify the strength of influence between arbitragers and speculators.

2.2.1 Arbitragers Excess Demand in Foreign Exchange Forward Market

In conceptualizing the hypothesis, in perfect foreign exchange forward markets the influence of arbitragers and speculators will be equivalent while in imperfect foreign exchange forward markets the influence of arbitragers and speculators will not be equivalent. Based on Moosa (1999), the arbitragers' excess demand in the foreign exchange forward market can be defined as

$$Ar_t = a\left(\dot{F}_t^{\,t+1} - F_t^{\,t+1}\right) \quad (8)$$

and $a > 0$ Where Ar_t is the arbitragers excess demand in the foreign exchange forward market,

$F_t^{\,t+1}$ is the actual one period foreign exchange forward rate determined at time t but applicable to delivery at time t+1 and $\dot{F}_t^{\,t+1}$ is the equilibrium based foreign exchange forward rate from equation (3). When $\dot{F}_t^{\,t+1} > F_t^{\,t+1}$, it indicates $Ar_t > 0$, arbitragers will be net buyers of foreign exchange forward contracts and when $\dot{F}_t^{\,t+1} < F_t^{\,t+1}$, it indicates $Ar_t < 0$, arbitragers will be net sellers of foreign exchange forward contracts. Equilibrium is achieved when $\dot{F}_t^{\,t+1} = F_t^{\,t+1}$ at point of origin, where equilibrium based foreign exchange forward rate is equivalent to the actual the foreign exchange forward rate (see Figure 3).

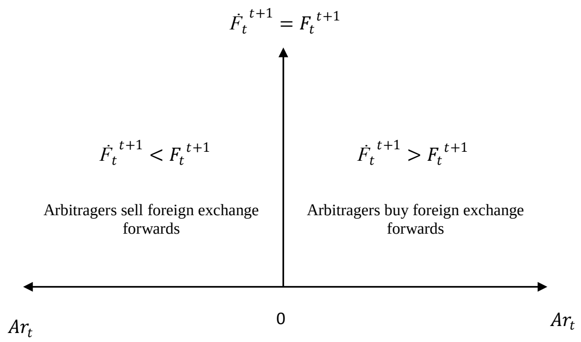

Figure 3 –Actual Foreign Exchange Forward Rate and Equilibrium Foreign Exchange Forward Rate

Equation (8) is estimated with Ar_t, which is the arbitragers excess demand function for foreign exchange forward as the dependent variable and the difference between equilibrium-based foreign exchange forward rate and the actual foreign exchange forward rate, $\dot{F}_t^{\,t+1} - F_t^{\,t+1}$ as the independent variable. In conceptualizing Ar_t it is treated as the carry to risk ratio, denoted as Υ and measured as $\Upsilon = \frac{i-i^*}{\sigma St}$ where $i - i^*$ is the carry return (difference in interest rates between the implied yield derived from the foreign exchange forward rate in the onshore foreign exchange market or the implied yield derived from the non-deliverable foreign exchange forward rate in the offshore foreign exchange market) and the US Dollar Libor interest rates which is the cost of trading in the foreign exchange forward market. The $i - i^*$ is defined as the carry in foreign exchange forward trading. The σSt is the spot exchange rate volatility which is defined as the risk in the foreign exchange forward market. The volatility is measured as the standard deviation of the foreign exchange spot rate. The carry to risk ratio signifies the amount of risk that can be undertaken by arbitragers in the foreign exchange forward market corresponding with the expected return on the foreign exchange forward position. Based on the carry to risk ratio and the difference between equilibrium-based foreign exchange forward rate and the actual foreign exchange forward rate, the arbitragers excess demand function for foreign exchange forward is formulated as

$$\Upsilon = c + a\left(\dot{F}_t^{\,t+1} - F_t^{\,t+1}\right) + \varepsilon_t \qquad (9)$$

Where $\Upsilon = \frac{i-i^*}{\sigma S}$ is the carry to risk ratio, c is the constant, a is the coefficient of the arbitragers excess demand for foreign exchange forward and ε_t is the error term.

2.2.2 Speculators Excess Demand in Foreign Exchange Forward Market

Moosa (1999) indicates the speculators excess demand in the foreign exchange forward market Sp_t, can be defined as

$$Sp_t = b[E_t(S_{t+1}) - F_t^{\,t+1}] \qquad (10)$$

and $b > 0$, where E_t is the expected value operator, therefore $E_t(S_{t+1})$ is the expected one period foreign exchange spot rate to prevail at time *t+1* and $F_t^{\,t+1}$ is the actual one period foreign exchange forward rate determined at time *t* but applicable to delivery at time *t+1*. The difference between both these foreign exchange rate determines the speculators excess demand function, Sp_t in the foreign exchange forward market. When $E_t(S_{t+1}) > F_t^{\,t+1}$, it indicates speculators in the spot foreign exchange market are net buyers of foreign exchange forward contracts and if $E_t(S_{t+1}) < F_t^{\,t+1}$, then speculators in the spot foreign exchange market are net sellers of foreign exchange forward contracts. Equilibrium is achieved when the expected spot foreign exchange rate equals to the actual foreign exchange forward rate, when $E_t(S_{t+1}) = F_t^{\,t+1}$ at point of origin (see Figure 4).

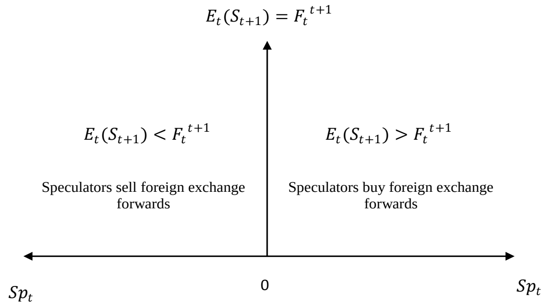

Figure 4 –Expected Spot Foreign Exchange Rate and Actual Foreign Exchange Forward Rate

By treating the speculators excess demand function for foreign exchange forwards Sp_t as the expected one period foreign exchange spot rate to prevail at time *t+1* which is $E_t(S_{t+1})$, therefore it can be expressed as

$$Sp_t = E_t(S_{t+1}) \qquad (11)$$

In identifying the expected one period foreign exchange spot rate $E_t(S_{t+1})$ to prevail at time *t+1*, it is based on the foreign exchange spot rate St at time *t*, where

$$E_t(S_{t+1}) = (S_t), \qquad (12)$$

Therefore from equations (10), (11) and (12), the speculators excess demand function for foreign exchange forward can be formulated as

$$St = c + b[E_t(S_{t+1}) - F_t^{\,t+1}] + \varepsilon_t \quad (13)$$

Since $Sp_t = E_t(S_{t+1})$ and $E_t(S_{t+1}) = (S_t)$ based on equation (11) and equation (12), therefore equation (13) indicates the dependant variable which is the foreign exchange spot rate St at time *t* and the independent variables being $E_t(S_{t+1}) - F_t^{\,t+1}$, which is the difference between the one period foreign exchange spot rate to prevail at time *t*+1 and the actual one period foreign exchange forward rate determined at time *t* but applicable to delivery at time *t+1*. From equation (13), *c* is the constant, b is the coefficient of the speculators excess demand for foreign exchange forward and ε_t as the error term.

2.2.3 Integrating Arbitragers and Speculators Excess Demand in Foreign Exchange Forward Market

Equilibrium in the foreign exchange forward market will not be tenable if arbitragers and speculators are consistently net buyers or net sellers of foreign exchange forward contracts. This requires zero excess demand function for arbitragers and speculators, where $Ar_t + Sp_t = 0$. Integrating equation (9) and (13) to solve the actual one period foreign exchange forward rate determined at time *t* but applicable to delivery at time *t+1* is formulated as

$$F_t^{\,t+1} = \left[\frac{a}{a+b}\right]\dot{F}_t^{\,t+1} + \left[\frac{b}{a+b}\right] E_t(S_{t+1}) \quad (14)$$

Whereby equation (14) indicates the actual one period foreign exchange forward rate determined at time *t* but applicable to delivery at time *t+1* is a weighted average of the equilibrium based foreign exchange forward rate and the expected spot rate, where, the coefficient for arbitragers is measured as

$$\psi = \frac{a}{a+b} \qquad (15)$$

and the coefficient for speculators is measured as

$$\theta = \frac{b}{a+b} \qquad (16)$$

Given the coefficient for arbitragers and speculators, under conditions where $\psi > \theta$, arbitragers have a greater influence in foreign exchange forward markets than speculators. While under conditions where $\psi < \theta$, speculators have a greater influence in foreign exchange forward markets than arbitragers.

3 Problem Solution

3.1 Unit Root Test for Stationary

The forward gap and carry return are tested for stationary properties using the Augmented Dickey-Fuller test. The test included a constant with a maximum lag of five periods and without a trend. The test results show no evidence of non stationary, therefore rejecting the null hypothesis of having a unit root and rejecting any possibility of a spurious relationship (see Table 1)

Table 1 Augmented Dickey - Fuller results of Unit Root Test

	Forward Gap		Carry Return	
	Onshore	Offshore	Onshore	Offshore
INR	-2.9348	-4.8438	-29.6920*	-4.1977
KRW	-26.4639*	-4.7661	-21.6042*	-2.9080
IDR	-3.4249	-18.6552*	-26.2988*	-4.5431
MYR	-24.3830*	-5.1276	-29.6985*	-4.4957

Source: Author's calculation.
Notes: The *t*-statistic is significant in rejecting the null hypothesis of having unit root at levels with 5% critical value.
*The *t*- statistic is significant in rejecting the null hypothesis of having unit root at first difference with 1% critical value.

The unit root test for all four EA forward gap and carry return show no evidence of unit root presence and indicate the series as stationary and having the property of mean reversion.

3.2 Deviation from Covered Interest Parity

Equation (6) is estimated using a least square approach with the forward gap $\dot{F}-F$ as the dependent variable and the carry return of $i-i^*$ as the independent variable. The coefficient b from equation (6) shows the magnitude of deviation from covered interest parity. The foreign exchange forward markets in EA were identified to be imperfect, where deviations from covered interest parity were found to be not equivalent to zero. The b coefficients are positive for all four EA currencies indicating that as the carry return increase; the forward gap moves in the same direction while the standard error of the regression reflects estimated variance of the residuals (see Table 2).

Table 2 Estimated Coefficient of Deviation from Covered Interest Parity

	Onshore		Offshore	
	b	Standard error of regression	*b*	Standard error of regression
INR	0.6803	0.1403	0.6104	0.5615
KRW	0.9294	0.4147	0.7184	0.8471
IDR	0.6807	0.8304	0.4870	1.3889
MYR	0.7103	0.1122	0.7403	0.3272

Source: Author's calculation.
Notes: The deviation from covered interest parity is based on equation (6), where $\dot{F} - F = a + b\left[\frac{F}{S}(1+i^*)\right] - 1) - i^* + \varepsilon_t$.
The coefficient b is in % terms which reflects the magnitude of deviation from covered interest parity.
Significant at the 5% level of *t*-Stat for both onshore and offshore coefficient.

EA currencies fail to achieve covered interest parity equilibrium in both the onshore and offshore foreign exchange forward markets but the positive coefficient of deviation from covered interest parity imply EA currencies as being inclined to appreciate against the US Dollar in the foreign exchange forward market. The appreciation tendency of EA currencies during the period of study show the carry return $i-i^*$ as below the forward gap $\dot{F}-F$ with agents in the foreign exchange markets inclined to buy EA currencies in the foreign exchange forward market.

The largest deviation in covered interest parity occurs for the KRW. The deviation is larger in the onshore foreign exchange forward market due to the accessibility given by Bank of Korea (BoK) for onshore residents to engage in offshore non-deliverable foreign exchange forward market for currency risk hedge purposes. The regulation encourages deviation in covered interest parity to occur and in the same vein raises the risk of capital outflow by onshore residents. The Indonesia Rupiah (IDR) also shows a large deviation from covered interest parity in the onshore foreign exchange forward market due to tight regulations imposed by Bank Indonesia to deter speculative activity. Indonesia imposes regulation pertaining to purchase of foreign exchange forward against the IDR by non-residents for amounts exceeding USD 100,000 and making it mandatory to obtain written permission from the Bank of Indonesia (BI)[3]. This

[3] Tsuyuguchi, Y and Wooldridge, P, (2008) find that activity in Asian currencies is concentrated in the onshore foreign exchange markets. This indicates that foreign exchange controls are having the intended

control limits the amount of foreign exchange that flows in and out of Indonesia's foreign exchange system

MYR is the only currency that shows a small deviation from covered interest parity occurring in the onshore foreign exchange forward market compared to the offshore foreign exchange forward market. During the GFC of 2008, financial trading counterparty risk was a significant factor for consideration in trading of EA currencies. Limited counterparties for settlement of foreign exchange trades by financial institutions in the onshore foreign exchange forward market as well as the foreign exchange risk premium in dealing with foreign financial institutions meant central bank of Malaysia having to act as a significant counterparty in settlement of currency trades[4]. This was done by intervening in both the foreign exchange spot market and the foreign exchange forward market[5]. Effective intervention and reliance on monetary policy signalling were crucial factors in limiting the deviation from covered interest parity in the onshore foreign exchange forward market.

In all four EA foreign exchange forward markets with the exception of MYR, the deviation of covered interest parity is larger in the onshore foreign exchange forward market than in the offshore foreign exchange forward market. Two factors have been identified for occurrence of smaller deviation in the offshore foreign exchange forward market. First, the US Dollar is the preferred currency for settlement of foreign exchange trading in the offshore foreign exchange forward market given the depth of liquidity of the US Dollar in international foreign exchange markets and the convertibility of the US Dollar in the current and capital account

effect of stalling the internationalization of Asian currencies and therefore potentially hindering the integration of Asian financial markets with global markets. The authors also find foreign exchange controls act as a restraining factor in the development of Asian foreign exchange derivatives trading which segments foreign exchange activity between onshore and offshore markets.

[4] The sale and purchase of foreign exchange are subject to stringent controls and this adds to the difficulties faced by currency traders in finding counterparties with whom to hedge or close out their positions.

[5] Kriljenko (2004), conclude in their findings that foreign exchange regulations and the role of the central bank heavily influence the structure of the market. This is consistent with the findings of Miniane (2004) and Wooldridge and Tsuyuguchi (2008), where the relatively low share of trading with onshore agents in the foreign exchange market is due to Asia's low degree of capital mobility. Foreign exchange turnover and the mechanism of reaching equilibrium are higher in countries with open capital accounts and low barriers to inward and outward investment facilitate the international diversification of portfolios.

Second, the transaction in trading of foreign exchange forward involves two legs. The US Dollar leg of the transaction has to be done with the Federal Reserve Bank of New York where there is a time difference between EA foreign exchange trading hours and US foreign exchange trading hours. The EA currency leg involves settlement of foreign exchange trading with an EA financial counterparty. The time lag exposes foreign exchange traders to Herstatt risk[6] when dealing in local EA currencies against the US Dollar. In situations where the receipt and payment of currencies are mismatched, foreign exchange traders may be forced to use emergency lines with central banks to close out these positions. To avoid a currency mismatch and Herstatt risk, foreign exchange traders in the offshore foreign exchange forward market use the US Dollar instead, this is the preferred currency for settlement of foreign exchange trading. The convenience of using the US Dollar as settlement for foreign exchange trading circumvents the need to use the onshore foreign exchange forward market where settlement of foreign exchange trades are in the local currency.

3.3 Actual Foreign Exchange Forward Rate Undershoots the Equilibrium based Foreign Exchange Forward Rate

Consistent with equation (8), the coefficient for arbitragers' excess demand for foreign exchange forwards is positive where $a > 0$ in both the onshore and offshore foreign exchange forward markets. It is also identified that the actual one period forward rate of F_t^{t+1} at time t undershoots the equilibrium based foreign exchange forward rate

[6] Herstatt risk is a form of settlement risk in foreign exchange markets that occurs when a counterparty does not deliver the security or its value in cash as per agreed when the security was traded after the other counterparty had delivered the security or its value in cash as per the trade agreement. The Herstatt risk is named after a German bank that made a famous example of the risk on 26th June 1974 when the bank's license was withdrawn by German regulators at the end of the banking day (4:30pm local time) because of a lack of income and capital to cover liabilities that were due. But some banks had undertaken foreign exchange transactions with Herstatt and had already paid Deustche Mark to the bank during the day, believing they would receive US Dollars later the same day in the US from Herstatt's US nostro account. However, after 4:30 pm in Germany and 10:30 am in New York, Herstatt stopped all US Dollar payments to counterparties, leaving the counterparties unable to collect their payment.

of $\dot{F}_t^{t+1}$ in all four EA onshore and offshore foreign exchange forward markets, implying arbitragers as net buyers of foreign exchange forward contracts (see Table 3.).

Table 3 Arbitragers Excess Demand Function for Foreign Exchange Forwards

	Onshore		Offshore	
	a	Standard Error of coefficient	a	Standard Error of coefficient
INR	0.7048	0.0028	0.7452	0.0066
KRW	0.0093	0.0000	0.0078	0.0002
IDR	0.0013	0.0000	0.0020	0.0000
MYR	6.4592	0.0315	5.3409	0.0778

Source: Author's calculation.
Notes: Equation (9) is estimated using a least square approach. The independent and dependent variables are measured in % terms. Coefficient a is significant at 10% critical t values for all four EA currencies.

In evaluating the coefficient for arbitragers in the foreign exchange forward market, MYR reflect large values in both the onshore and offshore foreign exchange forward market in relative to the rest of EA currencies. This implies that the undershoot of the actual one period forward rate of F_t^{t+1} at time t from the equilibrium-based foreign exchange forward rate of $\dot{F}_t^{t+1}$ has a very large effect on the carry to risk ratio, indicating the high degree of sensitivity by arbitragers for these currencies.

3.4 Actual Foreign Exchange Forward Rate Undershoots the Expected Foreign Exchange Spot Rate

Consistent with equation (10) the coefficient for speculators excess demand in the foreign exchange forward is positive where $b > 0$ in both the onshore and offshore foreign exchange forward markets for all ten EA currencies. The actual one period foreign exchange forward rate determined at time t, which is F_t^{t+1}, undershoots the expected one period foreign exchange spot rate to prevail at time $t+1$ which is $E_t(S_{t+1})$, implying speculators as net buyers of foreign exchange forward contracts (see Table 4).

Table 4. Speculators Excess Demand Function for Foreign Exchange Forwards

	Onshore		Offshore	
	b	Standard Error of Coefficient	b	Standard Error of Coefficient
INR	0.0457	0.0028	0.0047	0.0014
KRW	0.1261	0.0046	0.0347	0.0031
IDR	0.0010	0.0004	0.0008	0.0002
MYR	0.1321	0.0053	0.0010	0.0004

Source: Author's calculation.
Notes: Equation (13) is estimated using a least square approach. The independent and dependent variables are measured in % terms. Coefficient b is significant at 10% critical t values for all four EA currencies. For IDR and MYR in the onshore and offshore foreign exchange forward market, estimates of the speculators excess demand uses the change in the values of spot foreign exchange rate and the change in values of the difference between the expected foreign exchange spot rate and the actual foreign exchange forward rate.

In evaluating the magnitude of the coefficient for speculators excess demand for foreign exchange forwards, it is large for MYR in the onshore foreign exchange forward market and for KRW in the offshore foreign exchange forward market.

3.5 Influence of Arbitragers and Speculators are not Equivalent

The influence of arbitragers and speculators are not equivalent in EA foreign exchange forward markets, indicating EA foreign exchange forwards markets as imperfect. Given the identification of the arbitragers and speculators excess demand coefficient for foreign exchange forwards, the computation of equation (15) and (16) show arbitragers have a greater influence in EA foreign exchange forward markets, onshore and offshore (with the exception of the KRW) (see Table 5)

Table 5 Arbitragers and Speculators Coefficient

Currency	Onshore		Offshore	
	ψ	θ	ψ	θ
INR	1.0457	0.1104	1.0047	0.0111
KRW	1.1261	13.6143	1.0347	4.4897
IDR	1.0010	0.7706	1.0008	0.3740
MYR	1.1321	0.1525	1.0010	0.0012

Source: Author's calculation.
Notes: Calculation based on equation (15) and (16). In both the onshore and offshore foreign exchange forward markets the arbitragers influence is greater than the influence of speculators with the exception for KRW where speculators have a greater influence than arbitragers in the foreign exchange forward market. ψ is the coefficient for arbitragers and θ is the coefficient for speculators

The influence of arbitragers indicates inefficiency in the foreign exchange forward market and pricing mismatch are exploited by arbitragers.

Even though arbitragers are able to exploit the two tier foreign exchange forward market, this does not occur in the KRW foreign exchange market. Speculators were identified as having a greater influence in both the onshore and offshore foreign exchange forward market. Significant volatility in the onshore foreign exchange forward gap (difference between the equilibrium and actual foreign exchange forward rate) deters arbitragers from undertaking arbitraging activity. The high volatility detected in the onshore foreign exchange forward market in KRW poses a risk to arbitragers since there is a greater degree of experiencing losses when arbitraging activity is undertaken.

4 Conclusion

In a two tier EA foreign exchange forward market, it has been identified that EA currencies fail to achieve covered interest parity equilibrium in both the onshore and offshore foreign exchange forward market. The largest deviation in covered interest parity occurs for the KRW and IDR and the deviation is larger in the onshore foreign exchange forward. MYR is the only currency that shows a small deviation from covered interest parity occurring in the onshore foreign exchange forward market compared to the offshore foreign exchange forward market.

The volatility of the forward gap was found to be not equivalent to zero in all four EA currencies. In comparing the forward gap volatility of the onshore and offshore foreign exchange forward markets in EA, the differences were significant. In the onshore foreign exchange forward market, the volatility of the forward gap for INR, IDR and MYR were lower compared to the volatility of the forward gap in the offshore foreign exchange forward market. In comparing the volatility of arbitrage profit and loss, the magnitude of arbitrage profit and loss diverges between onshore and offshore foreign exchange forward market. The onshore volatility of arbitrage profit and loss is smaller compared to the offshore foreign exchange forward market.
In evaluating the influence of arbitragers and speculators excess demand function for foreign exchange forwards, findings show arbitragers generally have a greater influence in both the onshore and offshore EA foreign exchange forward markets.

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