The twin faces of emerging Asia's currency forward markets in an imperfect setting

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To cite this article: Suresh Ramanathan & Kian-Teng Kwek (2013) The twin faces of emerging Asia's currency forward markets in an imperfect setting, Applied Financial Economics, 23:18, 1433-1446, DOI: 10.1080/09603107.2013.831169

To link to this article: http://dx.doi.org/10.1080/09603107.2013.831169

Published online: 28 Aug 2013.

Article views: 98

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The twin faces of emerging Asia’s currency forward markets in an imperfect setting

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Covered interest parity fails to occur in both the onshore and offshore currency forward markets for emerging Asia. The deviation is largely influenced by a two-tier currency forward market given the barriers to capital flow, with the exception of Hong Kong. The structural difference between onshore and offshore currency forward markets lends support for arbitrageurs to exploit the segmentation of markets.

Keywords: deviation from covered interest parity; nondeliverable forward markets; emerging Asia; Mundell Fleming; currency forwards

JEL Classification: C32; E00; F41; F31; F37

I. Introduction

Stable exchange rates, independent monetary policy, free capital flows, the trilemma or impossible trinity suggests that only two of the above three goals can be accomplished simultaneously (Fleming, 1962; Mundell, 1963). Evidence thus far by researchers is mixed. China achieves stable exchange rates and independent monetary policy and chooses to have some capital controls as findings by Mankiw (2010) indicate. But can the trilemma be considered as a guide for macroeconomic policy framework? The findings by Obstfeld et al. (2005) suggest that this is the case. Economies that are without a pegged exchange rate and have barriers to capital mobility retain sufficient amount of monetary independence whereas economies with pegged exchange rates do not have barriers to capital mobility and would lose significant monetary independence. Yu Hsing (2012) finds that there is support for trilemma for Malaysia, the Philippines and Singapore and lack of evidence of trilemma for Indonesia and Thailand. Policy combinations prevail in Malaysia, the Philippines and Singapore and that a country may switch to a different policy combination over time in order to deal with major economic events. The Mundell Fleming model in an emerging Asia context incorporates two fundamental aspects (see Fig. 1), namely the market-driven space and policy-driven space.

In the standard model, points A, B and C remain, indicating the choice for policy-makers is limited and adheres to only two points of preference, where the distance between A and C is exchange rate fixing, A and B is monetary policy independence and B and C is capital mobility. In emerging Asia, strict proposition of the Mundell Fleming model is a constraint for policy-makers, taking into account of the lessons learnt during the 1997/98 Asian financial crisis. Consistent with this objective, Aizenman et al. (2011) finds that in developing economies maintaining exchange rate stability was a top priority up to 1990, and since 2000, they pursued and managed exchange rate flexibility and retained some monetary policy independence. The task of managing capital mobility is to keep it in-line within macroeconomic targets of the domestic economy thus the introduction of point D which is the market-driven space and point E, the policy-driven

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space. The midpoint of $D$ and $E$ is a policy combination mix, where the degree of capital mobility between $A$ and $D$ is adjusted via the policy combination mix. The management of capital flow in emerging Asian markets while is within the same plane of $A$ and $E$, the adjustment process for policy-makers is done via the distance between $D$ and $E$. As $E$ stays as the centre of the Mundell Fleming model, the point $E$ now interfaces with $D$ and $A$. The flow of policy now is caught between either a no capital mobility point of $A$ or a full capital mobility point of $D$ (see Fig. 2).

In these both extreme cases, the point $E$ plays an integral role of adjusting the policy-driven space. The policy combination mix takes into account the external and internal environment and the adjustment is done accordingly.

This research focuses on covered interest parity theorem, but the imposition of capital controls in the form of highly rigid or mild form has to a certain extent questioned the workings of this theory. In emerging Asia following the 1997/1998 crisis, capital mobility experienced a love–hate relationship with policy-makers. Given uncertain conditions that may be imposed or relaxed with capital flows, markets have been at the mercy of policy-makers, creating an opportunity cost. The development of the offshore currency forward market in major centres such as London, New York and Singapore for offshore currency forward trading since the late 1990s was the beginning of a new chapter on currency trading. The offshore nondeliverable forward (NDF) is an instrument that settles in Dollar terms, does not force currency traders to have an underlying asset in the onshore market and works alongside in a parallel fashion with the onshore market. This article evaluates deviation from covered interest parity using forward gap and carry return. The significance being to measure the deviation by incorporating the onshore currency forward and offshore nondeliverable currency forward (NDF). Further extensions are made to include the behaviour of deviation from covered interest parity during the global crisis period and modelling arbitrageurs excess demand function followed by a speculators excess demand function for forward exchange rate. Each function is replicated for both the onshore and offshore currency forward market. Section II briefly explains the difference between covered interest arbitrage and covered interest parity. Section III introduces the framework. Section IV reports findings of this exercise followed by concluding remarks in the final section.
Emerging Asia’s currency forward markets in an imperfect setting

II. Covered Interest Arbitrage and Covered Interest Parity

Covered interest arbitrage and covered interest parity are two terms that are often interchangeably used in financial markets, but there is a crucial difference between both. Covered interest arbitrage is an arbitrage trading strategy whereby an investor capitalizes on interest rate differential between two countries by using the currency forward contract to cover or to eliminate exposure to exchange risk (Madura, 2007). The currency forward contract enables arbitrageurs to make use of the forward premium or the discount to earn a riskless profit from discrepancies between the two countries’ interest rates.1 Opportunity to earn riskless profits arises from the reality that the interest rate parity condition does not constantly hold. When spot and forward exchange rate markets are not in a state of equilibrium, arbitrageurs will no longer be indifferent among the available interest rates in the two countries and will invest in whichever currency that offers a higher rate of return. The forward contract variable in the covered interest arbitrage condition plays a significant role in determining arbitraging profits, and findings from Dunn and Mutti (2004) reveal that the imposition of foreign exchange controls is a determinant of these profits when it is enforced on forward contracts.

Covered interest parity instead occurs when the no-arbitrage condition is satisfied with the use of a forward contract to hedge against exposure to exchange rate risk, and interest rate parity is covered. Agents in the market will still be indifferent among the available interest rates in the 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. Covered interest rate parity holds when there is open capital mobility and limited capital controls. That said, the lessons learn from the 2008/2009 crisis however indicate that even in an environment of open capital mobility, the uncertainty about counterparty risk has become a significant determinant of covered interest parity deviations (Coffey et al., 2009).

III. The Framework

The underlying covered interest parity model is based on the following equation

\[ F = S \frac{1 + i}{1 + i^*} \]  

(1)

\( F \) is the forward rate (offshore nondeliverable forward), \( S \) is the spot exchange rate of the emerging Asian currency against the US Dollar, \( i \) is the onshore interest rate (both onshore currency forward yield and the offshore nondeliverable forward yield is used as the proxy) and \( i^* \) is the offshore 3-month US Dollar London Interbank Offered interest rates (proxy for funding rate for currency forward trades). The augmented Equation 2 from Equation 1 is in the form of:

\[ (1 + i) = \frac{F}{S} (1 + i^*) \]  

(2)

where,

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

is the implied yield obtained from currency forward for both onshore forward and offshore NDF.

This equilibrium condition from Equation 2 indicates that gross domestic return is equal to gross covered foreign return at the forward 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 rate, hence covering foreign exchange risk. By deriving further Equation 2 to be consistent with covered interest parity and to distinguish between the actual forward rate \( F \) (which prevails whether or not covered interest parity holds) and the equilibrium rate (denoted as \( \hat{F} \)), the covered interest parity equilibrium condition can be written as:

\[ \hat{F} = F \]

(3)

where,

\[ \hat{F} = S \left( \frac{1 + i}{1 + i^*} \right) \]

This covered interest parity equilibrium implies equality between interest parity forward rate and the actual forward rate. The spread between the equilibrium-based covered interest parity forward rate and the actual forward rate is a

---

1 The forward rate is said to contain a premium or discount, reflecting the interest rate differential between two countries, \( F = S(1 + P) \) where, \( P \) is the premium (if positive) or discount (if negative). \( F \) is the forward currency contract and \( S \) is the spot exchange rate. In practice, forward premiums and discounts are quoted as annualized percentage deviations from the spot exchange rate, in which case it is necessary to account for the number of days to delivery as in the following example \( P_N = \left( \frac{F}{S} - 1 \right) \times \frac{360}{N} \). \( N \) represents the maturity of a given forward exchange rate quote and \( d \) represents the number of days to delivery.
reflected of deviation from covered interest parity (see Fig. 3).

When \( F > \hat{F} \) it is overshooting and \( F < \hat{F} \) it is under-shooting, this reflects whether the actual forward rate depreciates or appreciates in the forward exchange rate. The deviation from covered interest parity is reflected as:

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

where,

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

and, \( i - i^\# \) as the money market gap.

Equation 4 indicates that the difference between the equilibrium forward rate and actual forward is determined by the currency return denoted by the difference from implied yield derived from the forward currency rate and the foreign interest rate. The deviation process is measured by two main components, with the forward gap as the dependent component and the carry return as the independent component.²

Using the framework, forward gap being determined by the carry return, the scaled difference technique of using fitted values for the observation between the original equation and an equation estimated without that observation² is applied. The objective being to gauge the impact of the global crisis of 2008 on deviation from covered interest parity.

In modelling deviation from covered interest parity, daily data for ten emerging Asian currencies against the United States Dollar (USD) is used.³ The emerging Asian currencies uses the spot exchange rate against the USD, the 3-month onshore and offshore forward rate, the 3-month US Dollar London Interbank offered rate and the 3-month implied yield for the onshore and offshore currency forward market and respective interbank rates.⁴ The period of analysis is between 2 June 2008 and 30 September 2011. The 10 emerging Asian currencies include Chinese Yuan (CNY), Indian Rupee (INR), Korean Won (KRW), Taiwan Dollar (TWD), Hong Kong Dollar (HKD), Singapore Dollar (SGD), Indonesia Rupiah ( IDR), Thai Baht (THB), Malay Ringgit (MYR) and Philippine Peso (PHP).

\[ A_{\chi t} = a (\hat{F}_{t+1}^e - F_{t+1}), a > 0 \] (5)

\( F_{t+1}^e \) is the actual one period forward rate determined at time \( t \), but applicable to delivery at time \( t+1 \) and \( \hat{F}_{t+1}^e \) is the equilibrium interest parity forward rate calculated from Equation 12. When \( \hat{F}_{t+1}^e > F_{t+1}^e \) it indicates \( A_{\chi t} > 0 \), arbitrageurs will be net buyers of forward contracts and when

² \( F - \hat{F} \) is the forward gap between the \( \hat{F} \) equilibrium forward rate and the actual currency forward on the onshore and offshore market.
³ Two equilibrium forward rate is identified, one for the onshore and the offshore market. The currency return is measured as the difference between the implied yield from the currency forward and the difference against the 3-month Dollar Libor rate. Where the implied yield is \( i = \frac{F}{S} (1 + r^*) - 1 \). The equation is estimated using least square and adjusted to percentage terms.
⁴ The DFFITS is the scaled difference in fitted values for the observation between the original equation and an equation estimated without that observation. Scaling is done by dividing the difference by an estimate of the SD of the fit. \( DFFITS = \left( \frac{e}{\hat{e}} \right)^{0.5} \). \( e \) is the original residual for each observation of \( k \), \( s \) is the variance of the residual that would have resulted had observation \( k \) not been included in the estimation and \( h \) is the \( k \)-th diagonal element of the Hat matrix \( x^\prime (X^\prime X)^{-1} Xk \).
⁵ All data that is used for this analysis was sourced from Reuters.
⁶ The interbank rates are China – 3m Shanghai Interbank Offered rate, India – 3m Mumbai Interbank Offered rate, S. Korea – 3m Certificate of Deposit rate, Taiwan – 3m Commercial Paper, Hong Kong – 3m Hong Kong Interbank Offered rate, Singapore – 3m Swap offered rate, Indonesia – 3m Average Auction yield paper, Thailand – 3m Bangkok Fixing rate, Malaysia – 3m Kuala Lumpur Interbank Offered rate, Philippines – 3m Reference rate.
\( F_t^{t+1} < F_t^{t+1} \) it indicates \( A\chi_t < 0 \), arbitrageurs will be net sellers of forward contracts (see Fig. 4).

The action of arbitrageurs allows market mechanism to reach the equilibrium point of 0, where equilibrium interest parity forward rate is equivalent to actual currency forward rate. Equation 5 is estimated using ordinary least square with \( A\chi_t \) as the dependent variable and the difference between \( \_F_t^{t+1} \) and \( F_t^{t+1} \) as the independent variable.6

\[ A\chi_t = c + \alpha \left( F_t^{t+1} - F_t^{t+1} \right) + \kappa, \]  

where \( c \) as a constant and \( \kappa \) as the error term.

6 Equation 5 is estimated using a least square approach, in the following manner, \( A\chi_t = c + \alpha \left( F_t^{t+1} - F_t^{t+1} \right) + \kappa \), with \( c \) as a constant and \( \kappa \) as the error term.

\( E_t(S_{t+1}) \) is treated as the carry-to-risk ratio, denoted as \( Y \) and measured as \( Y = \frac{\theta - \Psi}{\sigma} \), where \( \sigma \) is the spot exchange rate volatility. The carry-to-risk ratio signifies the amount of risk that can be undertaken by agents in the currency forward market corresponding to expected return on the currency forward position.7

7 Herman Kamil and Alejandro Reveiz, Carry Trade and Derivatives market in Columbia, Mechanisms and Policy Implications, Regional Workshop on Derivatives Market, 24 April 2008.

The expected spot rate at time \( t + 1 \) is determined by the spot rate at time \( t \). The expected spot rate is regressed against current spot rate using the least square approach, where \( S\chi_t \) is the dependent variable and the difference between \( E_t(S_{t+1}) \) and \( F_t^{t+1} \) as the independent variable.8

\[ S\chi_t = c + \beta \left( E_t(S_{t+1}) - F_t^{t+1} \right) + \kappa, \]

where:

\[ \frac{\alpha}{\alpha + \beta} = \psi \quad \text{and} \quad \frac{\beta}{\alpha + \beta} = \theta \]

8 Equation 6 is estimated using a least square approach, in the following manner, \( S\chi_t = c + \beta \left( E_t(S_{t+1}) - F_t^{t+1} \right) + \kappa \), with \( c \) as a constant and \( \kappa \) as the error term.

Fig. 4. Arbitrageurs action when actual currency forward rate diverges from equilibrium interest parity forward rate

Source: Author’s compilation.

The expected spot rate at time \( t + 1 \) is determined by the spot rate at time \( t \). The expected spot rate is regressed against current spot rate using the least square approach, where \( S\chi_t \) is the dependent variable and the difference between \( E_t(S_{t+1}) \) and \( F_t^{t+1} \) as the independent variable.8 If \( E_t(S_{t+1}) > F_t^{t+1} \), then \( S\chi_t \) indicates speculators in the spot exchange rate market are net buyers of forward contracts and if \( E_t(S_{t+1}) < F_t^{t+1} \), then \( S\chi_t \) indicates speculators in the spot exchange rate market as net sellers of forward contracts (see Fig. 5).

Equilibrium at 0 is achieved when the spot exchange rate equals to the actual forward rate.

Integration of arbitrageurs and speculators excess demand function

Equilibrium cannot exist if all market participants are net buyers or net sellers of forward contracts, since this requires zero excess demand, where:

\[ A\chi_t + S\chi_t = 0, \quad \text{therefore}, \]

Integrating Equations 6 and 7 to solve the forward rate

\[ F_t^{t+1} = \left[ \frac{\alpha}{\alpha + \beta} \right] F_t^{t+1} + \left[ \frac{\beta}{\alpha + \beta} \right] E_t(S_{t+1}) \]

where:

\[ \frac{\alpha}{\alpha + \beta} = \Psi \quad \text{and} \quad \frac{\beta}{\alpha + \beta} = \Theta \]
And if $\psi > \theta$, then arbitrage factor plays a more effective role than speculation in determining the forward rate and when $\psi = 1$ and $\theta = 0$, covered interest parity holds.

Equation 8 indicates the forward rate is a weighted average of the interest parity forward rate and the expected spot rate. The coefficients for arbitrageurs and speculators are integrated in a weighted average of the theoretical forward rate and the expected spot exchange rate to identify the forward rate. This identification provides the magnitude of influence of arbitrageurs and speculators in the currency forward market for both onshore and offshore.

**IV. Findings**

Measuring the coefficient of deviation from covered interest parity between both markets, HKD with its open economy shows no difference since there is no barrier to capital flow and no differentiation between onshore and offshore markets (see Table 1 for coefficients of deviation from covered interest parity and Fig. 6 for scatter plot of deviation from covered interest parity).

In the case of SGD, the onshore market reflects a larger deviation compared to the offshore market, which is attributed to significant interventionist stance by the Monetary Authority of Singapore (MAS) to smoothen excess volatility in the market. While SGD is also traded in the offshore market, its non国际化ization policy of the currency is to deter speculative attacks on the currency. This is because the SGD is used as a monetary tool and any form of speculative attack on the currency will have an impact on the island state’s monetary policy.

The largest deviation occurs for the KRW. The deviation from covered interest parity is larger in the onshore market due to the ability for onshore residents to engage in the offshore nondeliverable forward market for currency risk hedge purposes. This factor allows deviation in covered interest parity from reaching its equilibrium point, encouraging the risk of capital outflow by onshore residents. Though this outflow can be mitigated by intervention by the Bank of Korea (BoK), excessive intervention instead could derail the equilibrium point from being reached.

**Table 1. Estimated coefficient of covered interest parity deviation equation**

<table>
<thead>
<tr>
<th>Currency</th>
<th>Onshore</th>
<th>Offshore</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNY</td>
<td>0.7865</td>
<td>0.1972</td>
</tr>
<tr>
<td>INR</td>
<td>0.6803</td>
<td>0.1403</td>
</tr>
<tr>
<td>KRW</td>
<td>0.9294</td>
<td>0.4147</td>
</tr>
<tr>
<td>TWD</td>
<td>0.7091</td>
<td>0.4939</td>
</tr>
<tr>
<td>HKD</td>
<td>0.8277</td>
<td>0.0530</td>
</tr>
<tr>
<td>SGD</td>
<td>0.7491</td>
<td>0.1396</td>
</tr>
<tr>
<td>IDR</td>
<td>0.6807</td>
<td>0.8304</td>
</tr>
<tr>
<td>THB</td>
<td>0.7231</td>
<td>0.1525</td>
</tr>
<tr>
<td>MYR</td>
<td>0.7103</td>
<td>0.1122</td>
</tr>
<tr>
<td>PHP</td>
<td>0.7373</td>
<td>0.2182</td>
</tr>
</tbody>
</table>

*Significant at the 5% level of t-statistics for both onshore and offshore coefficient.

**Fig. 5. Speculators action when expected spot exchange rate diverges from actual currency forward rate**

*Source: Author’s compilation.*
For IDR, the deviation is also among the largest in the onshore market. This is due to Indonesia’s tight regulation pertaining to purchase of currency forwards against the IDR by nonresidents for amounts exceeding USD 100,000 and making it mandatory to obtain written permission from the Bank of Indonesia (BI). This control

9 Tsuyuguchi and Wooldridge (2008) find that activity in the Asian currencies is concentrated in onshore markets to a much higher degree than other major currencies. This indicates that foreign exchange controls are having the intended effect of stalling the internationalization of Asian currencies and therefore potentially hindering the integration of Asian financial markets with world markets. The authors also find that foreign exchange controls are restraining the development of Asian foreign exchange markets by depressing derivatives trading and segmenting activity between onshore and offshore markets.
limits the amount of foreign currency that flows in and out of Indonesia’s foreign exchange system, thus the ability for equilibrium to be achieved will be strongly dependent on the activity of onshore residents as well as the central bank.

TWD and MYR are the only two currencies that show a smaller deviation from covered interest parity occurring in the onshore market compared to the offshore market. At the height of the global crisis, counterparty risk was a significant factor for consideration in emerging Asian currency trading. The limitation due to fewer counterparties for settlement of currency trades imposed by agents in the onshore market as well as the risk premium in dealing with nonresidents based in the onshore market, suggest the

Fig. 6. (Continued).
ability to reach covered interest parity in the onshore market would have been strictly determined by the monetary authority in respective countries. The ability to achieve this equilibrium is done via intervention in both the spot exchange rate and the currency forward market in order to normalize the uncertainty in the onshore foreign exchange market. As the onshore market mechanism is faced by interventionist policies, onshore market markers in Taipei and Kuala Lumpur relied on signals and actions by respective monetary authority to limit the deviation from covered interest parity. In the case of no effective intervention (unsterilized intervention), the risk of a larger deviation from covered interest parity could have occurred, similar to the patterns reflected in the rest of the emerging Asian currencies.

In emerging Asia (with the exception of TWD and MYR), the deviation of covered interest parity is larger in the onshore market than in the offshore market. This occurs because there is a greater inclination to use the USD currency as the preferred settlement instrument in the offshore market. The Dollar is used as a vehicle currency of choice given it is the international medium of exchange. It has depth in its liquidity and faces no convertibility barriers on the capital account. However, in the onshore market, settlement of foreign exchange trades is done in the local currency though a local payment system. The Dollar leg of the transaction has to be done with the Federal Reserve Bank of New York where there is a time difference between Asian trading hours and US trading hours. The time lag exposes foreign exchange traders to Herstatt risk when dealing between local Asian currencies against the Dollar. In situations where the receipt and payment of currencies are mismatched, currency traders may be forced to use emergency lines with monetary authorities to close out these positions.

In the case of offshore markets, the settlement currency is the USD, the Herstatt risk is negligible. The deviation for covered interest parity in the offshore market is smaller compared to onshore market from the perspective of Herstatt risk. The convenience of using the USD as settlement for currency trades circumferences the need to use the onshore market where settlement of trades are in the local currency. This divergence in the settlement of trades induces the development of the offshore market as viable alternative to the onshore market.

**Impact of the global crisis on deviation from covered interest parity**

Using the framework of currency, forward gap being determined by the carry return, the offshore market was more sensitive to the deterioration of external conditions compared to the onshore market (see Fig. 7).

Consistency of sharp upward and downward spike noted in deviation from covered interest parity in all 10 emerging Asia currency forwards in the offshore market. The offshore market which uses the USD as the vehicle currency for settlement of trades and being more exposed to risk aversion of trades had a larger impact given the global crisis, particularly when investment bank Lehman Brothers filed for bankruptcy on 15 September 2008.

In the case of the HKD, the pegged exchange rate against the US Dollar and its monetary policy being tied

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

11 C. Krijenjko (2004) conclude in their findings that foreign exchange regulations and the role of the central bank heavily influence the structure of the market. Consistent with the findings of Miniane (2004) and Tsuyuguchi and Wooldridge (2008), the relatively low share of trading with onshore agents in the foreign exchange markets is due to Asia’s low degree of capital mobility. Foreign exchange turnover and the mechanism of reaching equilibrium is higher in countries with open capital accounts. Low barriers to inward and outward investment facilitate the international diversification of portfolios.

12 Herstatt risk is a form of settlement risk in currency markets that occurs when counterparty does not deliver the security or its value in cash as per agreement 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 26 June 1974, the bank’s license was withdrawn by German regulators at the end of the banking day (4:30 pm 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 Deutsche Mark the bank during the day, believing they would receive US dollars later the same day in the US from Herstatt’s US nostro account. But after 4:30 pm in Germany and 10:30 am in New York, Herstatt stopped all dollar payments to counterparties, leaving the counterparties unable to collect their payment.

13 The Continuous Linked Settlement (CLS) system was launched in 2002 based in Hong Kong to eliminate the risk associated with foreign exchange transactions. Only three Asian currencies can be settled through this system, the SGD, HKD and KRW. For those not settled through this system, a HKD–USD Dollar real time gross settlement (HKDRTGS) was introduced in Hong Kong in 2000 and a EUR real time gross settlement EURRTGS introduced in 2003. The HKDRTGS system facilitates the payment for HKD–USD and HKD–EUR transactions. Malaysia linked its MYRRTGS system to Hong Kong’s USDRTGS system in November 2006, and in 2007 almost 60% of the MYR–USD trades in Kuala Lumpur are settled simultaneously through this system (Bank Negara Malaysia 2008). In the case of non-deliverable forward currencies of emerging Asia which are traded in the offshore market, the CLS has a dedicated system of matching these trades. This includes all emerging Asia currencies to reduce the cost of transaction and to improve efficiency in trading nondeliverable forward currencies. The CLS settlement for non-deliverable forward currencies offers a complete straight through process, post-execution of trades to settlement, capturing various instructions for the life of the contract and provides matching, settlement and reporting services (see www.cls-group.com).
Fig. 7. Scaled difference in fitted values between observed equation and equation without observation

Source: Results from E-views statistical programme.
Fig. 7. (Continued).
to the US Federal Reserve Bank, suggest external shocks to the HKD is subject to policy actions by the US Federal Reserve Bank. Monetary authorities in Hong Kong did not impose any form of regulation during the crisis and post-crisis period, reflective of its open market economy. At the onset of the crisis, the deviation from covered interest parity was driven by two main factors: The first being the bankruptcy of Lehman Brothers on 15 September 2008 and second being in October 2008 when the US Federal Reserve bank cuts its fed fund target rate from 2.0% to 1.5% on 8 October 2008 and again by another 50 basis points to 1.0% on 29 October 2008. The external shock from lower US interest rates induced a corresponding cut in interest rates in HK from 3.5% to 2.0% on 9 October 2008 and again on 30 October 2008 from 2.0% to 1.5%. Interest rates were cut on 17 December 2008 from 1.5% to 0.5%. With interest rates being extremely low for Hong Kong, the daily money market operation was continuously used as a method to manage the USD–Kong, the daily money market operation was continuously.

Interest rates were cut on 17 December 2008 from 1.5% to 0.5%. With interest rates being extremely low for Hong Kong, the daily money market operation was continuously used as a method to manage the USD–HKD peg. The pressure on the USD–HKD currency forward market was intense during the period between January 2010 and September 2010 when the US Federal Reserve bank continued with its low interest rate policy of maintaining the Fed Funds target rate between 0.0% and 0.25%.

In the case of the KRW, the ability for onshore residents to engage in nondeliverable forward currencies to hedge their US Dollar exposure exacerbated the impact (Tsuyuguchi and Wooldridge, 2008). This consistency was also noted in the onshore currency forward of the KRW, where the magnitude of the crisis reflected similar styled patterns in both the onshore and offshore KRW markets. For SGD, though regulations were imposed on lowering the ceiling of NDF positions of banks trading books to one-fifth of banks’ FX trading, the impact however was negligible, but instead the deviation from covered interest parity took hold during July to August 2011. The 6-month swap offer rate (SGDSOR) was fixed at –0.066% on 10 August 2011, which was the first negative fixing in the history of the SGDSOR series. SGD swap offered rate is the onshore implied yield which is derived from the USD–SGD currency forward. The drop into the negative territory in SGDSOR was caused by the fall in USD–SGD currency forward rate.

Following the Fed’s pledge to keep its policy rates low for the next 2 years, USD–SGD forwards were pushed aggressively lower on the back of renewed appreciation pressure. Based on the interest rate parity condition, SGD swap offered rate is the level of interest rate that will make investors indifferent between placing a SGD deposit in Singapore or a USD deposit in the US after accounting for potential foreign exchange gains/losses. A negative interest forward implied rate therefore reflected the belief that any interest rate losses incurred on SGD deposits will be offset by future potential foreign exchange gains. This situation was remedied by the monetary authority intervening in the currency market via buying USD–SGD forward.

Monetary authorities in India and Philippines however were more concerned of the impact of offshore agents in the onshore foreign exchange markets. The actions taken by monetary authorities in these two countries were significant in inducing deviation from covered interest parity in the onshore market. In India, on June 2011, a decision was made to change the INR fixing mechanism to reduce the onshore–offshore interaction. The official Reserve Bank of India USD–INR fixing was polled from the select list of contributing banks at a randomly chosen 5-minute window between 10:30 am and 12:30 pm every weekday Mumbai time. This is then announced at 1:00 pm Mumbai time. In the past, fixing rates were determined by averaging the mean of the bid/offer rates polled from a few select banks around 12:00 pm every weekday.

The method of fixing introduced by RBI was a move to reduce the onshore–offshore currency forward market arbitrage that had been open to participants who had the advantage to operate in both markets. The other initiative introduced by RBI was to reduce the intraday spot volatility around the currency fixing itself. Implication from both these initiatives caused a reduction in liquidity in the interbank market around the fixing period due to increased uncertainty resulting in more volatility in the currency forward market. Given the change in fixing methodology, currency traders with these FX positions were forced to reduce their exposure in these trades and by default elevated volatility in the onshore currency forward market.

For PHP, on March 2011, Bankgo Sentralg Philippines (BSP) reviewed its reporting requirements for nondeliverable forwards (NDF). BSP encouraged onshore banks to voluntarily limit currency forward transactions in the offshore nondeliverable forward. The move dampened investor sentiment resulting in agents in the currency forward market to exit their short USD–PHPNDF position. The new reporting requirement of outright nondeliverable forward rates became increasingly determined by the USD–PHP spot currency movement and normal demand and supply from the offshore market. The forward gap between the offshore nondeliverable forward and the onshore forward rate widened as offshore agents had no opportunity to access onshore liquidity. The previous link between both onshore and offshore was now delinked as the offshore NDF increasingly became more influenced by demand and supply, while onshore currency forward were dictated by interest rate differentials.

With coefficient $a > 0$ for arbitrageurs demand function in both the onshore and offshore currency forward market, arbitrageurs are net buyers of forward contracts (see Table 2).

The implication being, the actual one period forward rate of $F_{t+1}^T$ at time $t$ undershoots the equilibrium interest parity forward rate of $F_{t+1}^T$. 

For speculators demand function, net sellers of currency forward contracts noted in the three currency pairs which include the CNY, IDR and PHP in both the onshore and offshore currency forward markets (see Table 3).

Expected spot exchange rate of \( E_t(S_{t+1}) \) continued to underperform the currency forward market, implying two factors at play, first being the uncertainty over direction of the spot exchange rate \( S_t \) at period \( t \), that curbs speculators excess demand function for currency forward rate. Second, unwinding of foreign exchange hedge risk positions that were accumulated in the currency forward market, prevalent in seven out of ten emerging Asia currencies in the nondeliverable forward offshore market.

Evaluating the influence of arbitrageurs and speculators in currency forward market, two key observations were noted from the findings (see Table 4).

First, arbitrageurs have a greater influence in determining the currency forward rate in both the onshore and offshore market. While regulatory framework in respective countries may have curbed speculative flows, arbitraging remain, indicating barriers to capital flows proliferates the offshore nondeliverable forward market for arbitraging activity. Even in highly liberalized economies such as Hong Kong and Singapore, arbitrageurs continue to exert their influence. In the case of HKD, even though there is no distinction made to onshore and offshore currency forwards, the prevalence of arbitraging activity is pronounced compared to speculative, given the limitation for speculative activity in the spot exchange rate of the HKD that is pegged against the USD in a tight range of 7.7500–7.8500. In the SGD case, the noninternationalization of the currency is a significant factor that provides the opportunity for arbitrage. The restriction on lending an aggregate amount not exceeding SGD 5.0 million per

Table 3. Speculators excess demand function for forward exchange rate*

<table>
<thead>
<tr>
<th></th>
<th>Onshore</th>
<th>Offshore</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNY</td>
<td>-0.031</td>
<td>0.002</td>
</tr>
<tr>
<td>INR</td>
<td>0.046</td>
<td>0.002</td>
</tr>
<tr>
<td>KRW</td>
<td>0.128</td>
<td>0.004</td>
</tr>
<tr>
<td>TWD</td>
<td>0.030</td>
<td>0.003</td>
</tr>
<tr>
<td>HKD</td>
<td>0.019</td>
<td>0.001</td>
</tr>
<tr>
<td>SGD</td>
<td>0.035</td>
<td>0.011</td>
</tr>
<tr>
<td>IDR</td>
<td>-0.063</td>
<td>0.002</td>
</tr>
<tr>
<td>THB</td>
<td>0.112</td>
<td>0.006</td>
</tr>
<tr>
<td>MYR</td>
<td>0.132</td>
<td>0.005</td>
</tr>
<tr>
<td>PHP</td>
<td>-0.034</td>
<td>0.003</td>
</tr>
</tbody>
</table>

Source: Results from E-views statistical programme.

Notes: *Equation (6) is estimated using a least square approach, in the following manner, \( S_t = c + b[E_t(S_{t+1})] + \kappa \), with \( c \) as a constant and \( \kappa \) as the error term.

HKD makes no distinction between an onshore and offshore currency forward market.
entity by onshore banks to nonresident financial markets and allowing nonresidents to hold local or foreign currency account in Singapore is a key factor in determining the ability for arbitrageurs to take advantage of the regulatory parameter.

The second observation, in all ten emerging Asia currencies, the arbitrageur’s coefficient $\psi$ is significantly different from unity, in the same vein as the speculators coefficient $\theta$ is different from zero, pointing towards the failure of covered interest parity to occur, this disequilibrium indicates the occurrence of imperfection in currency forward markets. With equilibrium failing to occur, the notion of classical interpretation of markets having the ability to clear itself fails to prevail, reflecting that for emerging Asia, currency regimes are still dictated by interventionist stance by monetary authorities and central banks. This framework of currency regimes itself is a factor that has developed arbitrageurs’ inclination to arbitrage.

V. Conclusion

Covered interest parity fails to occur in both the onshore and offshore currency forward markets for emerging Asia. The deviation is largely influenced by a two-tier currency forward market given the barriers to capital flow, with the exception of Hong Kong. The structural difference between onshore and offshore currency forward markets lends support for arbitrageurs to exploit the segmentation of market. The combination mix between market and policy space is crucial in sustaining the Mundell Fleming framework for emerging Asia, as it is modified to take into account the financial landscape of individual emerging Asia economy and the maturity of its currency markets. The nondeliverable forward market is a significant development in currency markets of emerging Asia that monetary authorities cannot ignore if they intend to manage the trilemma in an efficient manner.

Table 4. Arbitrageurs and Speculators coefficient

<table>
<thead>
<tr>
<th>Currency</th>
<th>$\psi$</th>
<th>$\theta$</th>
<th>$\psi$</th>
<th>$\theta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNY</td>
<td>0.97</td>
<td>-0.03</td>
<td>0.99</td>
<td>-0.01</td>
</tr>
<tr>
<td>INR</td>
<td>1.05</td>
<td>0.05</td>
<td>0.99</td>
<td>-0.01</td>
</tr>
<tr>
<td>KRW</td>
<td>1.13</td>
<td>0.14</td>
<td>1.04</td>
<td>0.04</td>
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<tr>
<td>TWD</td>
<td>1.03</td>
<td>0.03</td>
<td>0.97</td>
<td>-0.03</td>
</tr>
<tr>
<td>HKD$^\dagger$</td>
<td>1.02</td>
<td>0.02</td>
<td>1.02</td>
<td>0.02</td>
</tr>
<tr>
<td>SGD</td>
<td>1.04</td>
<td>0.04</td>
<td>1.02</td>
<td>0.02</td>
</tr>
<tr>
<td>IDR</td>
<td>0.94</td>
<td>-0.07</td>
<td>0.98</td>
<td>-0.02</td>
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<tr>
<td>THB</td>
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<td>0.12</td>
<td>0.95</td>
<td>-0.06</td>
</tr>
<tr>
<td>MYR</td>
<td>1.13</td>
<td>0.14</td>
<td>0.99</td>
<td>-0.01</td>
</tr>
<tr>
<td>PHP</td>
<td>0.97</td>
<td>-0.04</td>
<td>0.98</td>
<td>-0.03</td>
</tr>
</tbody>
</table>

Source: Author’s calculation.

Notes: Based on Equation 9 where, $\frac{\partial a}{\partial b} = \psi$ and, $\frac{\partial a}{\partial \sigma} = \theta$.

HKD$^\dagger$ makes no distinction between an onshore and offshore currency forward market.

References


Fleming, J. M. (1962) Domestic financial policies under fixed and floating exchange rates, IMF Staff Papers, 9, 369–79.


