HONG KONG MONETARY AUTHORITY

Research Memorandum 11/2018

21 December 2018

LINKED EXCHANGE RATE SYSTEM OPERATIONS – MECHANISM AND THEORY

Key Points:

- *Given the Linked Exchange Rate System (LERS) has experienced both capital inflows and outflows since 2008, the purpose of this paper is to investigate how the rules-based mechanism of the LERS works under such capital flows. The findings demonstrate the system is working according to its design and consistently with the recently developed target zone model, which adequately describes and explains the exchange rate dynamics and the associated interest rate differential in a fully credible target zone.*

- *Specifically, the paper provides a theoretical explanation of two empirical observations; (1) the sticky exchange rate dynamics near the Convertibility Undertaking (CU) rates (7.75 and 7.85); and (2) the persistent negative interest rate differential between the Hong Kong dollar and the US dollar. These observations address how the design of the LERS differs from a completely fixed exchange rate regime. The effects of the market operations including strong- and weak-side CUs on the HKD exchange rate and interest rates are discussed. In addition, making the policy environment less discretionary can have benefits in terms of increased credibility and hence greater robustness.*

Prepared by : *Research Department*
Hong Kong Monetary Authority

This paper was presented at the 14th Central Bank Conference on The Microstructure of Financial Markets held in Hong Kong on 5-6 November 2018. A shorter version of this paper appeared in the HKMA Quarterly Bulletin (December 2018). The views and analysis do not necessarily represent the views of the Hong Kong Monetary Authority.

I INTRODUCTION

Hong Kong's LERS has been in operation since 1983, under which the Hong Kong dollar (HKD) is fixed at a rate of 7.8 per US dollar (USD). In essence, the LERS is a currency board system, which requires both the stock and the flow of the Monetary Base (MB) to be fully backed by foreign reserves. Any change in the size of the MB has to be fully matched by a corresponding change in foreign reserves.[1] The LERS has undergone two major refinements since it was introduced: (1) the "seven technical measures"[2] in 1998; and (2) the "three refinements"[3] in 2005. In particular, the latter measure has brought the HKD exchange rate regime into a narrow-band (7.75 – 7.85) target zone with a currency board arrangement.

A study by Genberg and Hui (2011) after the two changes characterised both the "seven technical measures" and "three refinements" as making the system less discretionary over time. They found that decreasing the discretionary element (that is, by making LERS a more rules-based system) has led to an increase in the credibility of the arrangement. Their assessment was based on extracting information about exchange rate expectations from market prices, in part, by investigating exchange rate and interest rate volatility, as well as studying the dynamics of the exchange rate itself.

Since the US Federal Reserve (Fed) pursued its unprecedented quantitative easing policy following the 2008 global financial crisis, both the HKD and USD interest rates stayed at their zero lower bound for a lengthy period, with minimal interest rate differential between them. Hong Kong recorded continuous capital inflows between late-2008 and 2015. As the US economy showed signs of recovering, the Fed started to normalise its monetary policy by hiking its policy target rate since December 2015 and began reducing its balance sheet in October 2017. On 12 April 2018, the weak-side CU was triggered for the first time.[4] Given the LERS experienced both capital inflows and outflows during the periods under review, the episodes provided an opportunity to investigate how the rules-based

---

1 In Hong Kong, the Monetary Base comprises Certificates of Indebtedness (for backing the banknotes issued by the note-issuing banks), government-issued currency in circulation, the balance of the clearing accounts of banks kept with the HKMA (the Aggregate Balance), and Exchange Fund Bills and Notes.

2 The HKMA announced the "seven technical measures" on 5 September 1998, which included, (i) that there will be an explicit CU at 7.80 where the HKMA is obliged to convert HKD in the banks' clearing accounts into USD at the request of banks; (ii) expansion of the Monetary Base to include the outstanding Exchange Fund Bills and Notes; and (iii) the introduction of a Discount Window facility to ensure that interest rates will adequately respond to capital flows while allowing excessive and destabilising interest rate volatility to be dampened.

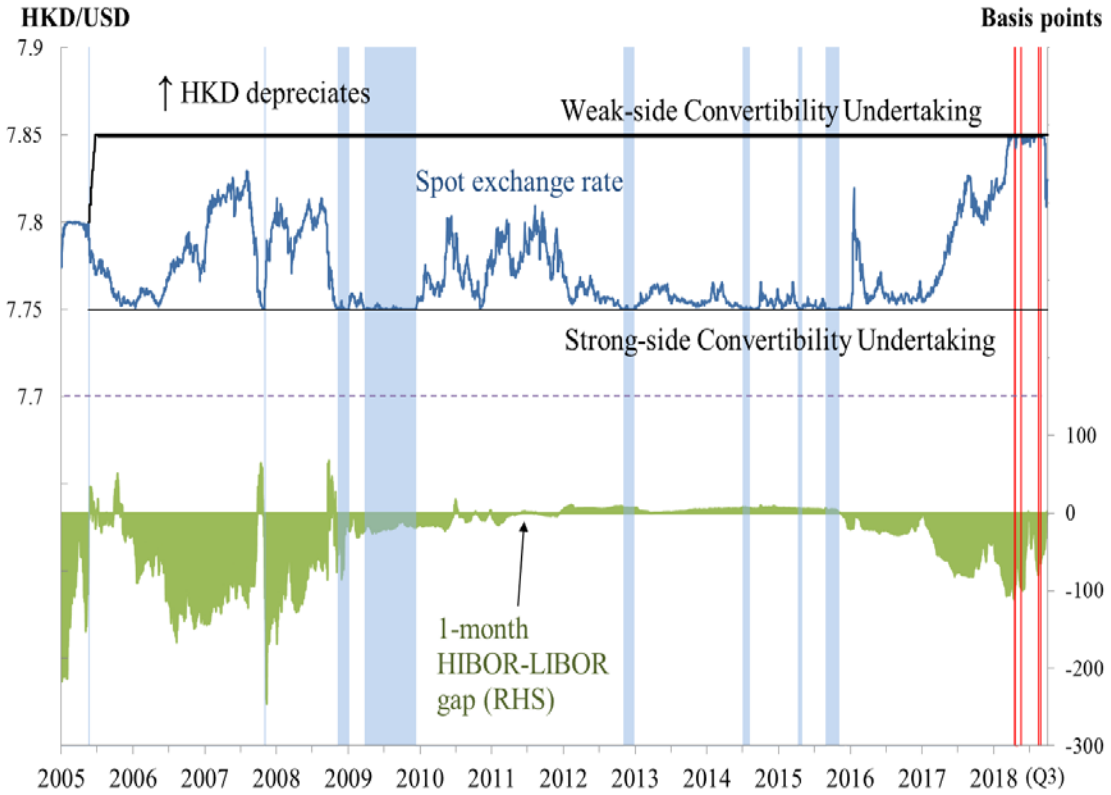
3 On 19 May 2005, the HKMA introduced the "three refinements". These were (i) the introduction of a strong-side CU by the HKMA to buy USD from licensed banks at HK$7.75 to US$1; (ii) the shifting of the HKMA's weak-side CU to sell USD to licensed banks from 7.80 to 7.85, to achieve symmetry around 7.80, thus creating a symmetric convertibility zone; and (iii) within the zone defined by the two CU levels, the HKMA may choose to conduct market operations consistent with the Currency Board principles, aimed at promoting the smooth functioning of the LERS.

4 As of September 2018, the weak-side CU was triggered 27 times, with capital outflows from HKD totalling HK$103.5 billion.

mechanism worked under such capital flows. The results demonstrated the LERS worked consistently according to its design as a credible target zone system based on the theories developed in recent exchange rate target zone literature. In particular, this paper answers questions about the relationship between the exchange rate and interest rate adjustments, and the sticky HKD exchange rate dynamics near the CU rates (7.75 and 7.85) under a target zone system operated with the Currency Board principles (Chart 1).

The paper is organised as follows. The next section presents the theoretical framework for the mechanism of the LERS. In particular, it discusses how the exchange rate dynamics under the LERS interacts with the interest rate differential between the HKD and USD, and the intrinsic stabilising mechanism in the system. Section 3 discusses the LERS operations under capital inflow and outflow episodes respectively, and provides empirical evidence supporting the theoretical framework. An event study on the effects of the triggering of the weak-side CU on HKD interest rates and exchange rates is also presented. The final section concludes.

Chart 1: HKD spot exchange rate and 1-month HIBOR-LIBOR differential



Note: The blue-shaded and red-shaded areas indicate triggering of the strong- and weak-side CUs respectively.

II THEORETICAL FRAMEWORK FOR THE LERS MECHANISM

Essential to a currency board system is a rule that requires any change in the monetary base to be brought about only by a corresponding change in foreign reserves in an anchor currency at a fixed exchange rate. The monetary base and foreign reserves should respectively be on the liability and asset side of the balance sheet of the monetary authority. For the LERS, the settlement of transactions arising from the strong- and weak-side CU between the HKD and USD changes the MB so that the automatic adjustment mechanism under the Currency Board can function to ensure exchange rate stability. Therefore, a currency board is a highly credible monetary policy framework provided the domestic currency is backed by liquid, risk-free assets denominated in the anchor currency, as is the case with the LERS.

In addition to exchange rate adjustment for deviations between the market and fixed exchange rates, a more effective adjustment mechanism of a currency board system works through interest rates. Capital inflows (outflows) will lead to corresponding decreases (increases) in domestic interbank interest rates, which are also reflected in the positive (negative) forward premiums on the currency. Provided a currency board is credible, the resultant interest rate differential creates interest rate arbitrage opportunities, therefore generating offsetting capital flows.[5] Investors sell (buy) domestic currency in exchange for the anchor currency, and this process narrows the difference between the domestic and anchor interest rates. Meanwhile, the market exchange rate remains close to the fixed exchange rate level or within the narrow target zone as in the LERS.

It is sometimes asserted that pegging the exchange rate entails a trade-off between interest-rate and exchange-rate variability. The argument is that to stabilise the exchange rate in the face of excess demand or supply in the foreign exchange market, the authorities must allow interest rates to adjust in order to induce offsetting capital flows. This raises the question of the relationship between the exchange rate and interest rate adjustments under a target zone system operated with currency board principles.

2.1 Theoretical framework

The traditional theoretical literature on exchange rate regimes does not distinguish narrow target zones from completely fixed exchange rates. With free capital mobility, a completely fixed exchange rate regime has zero differentials between the interest rates of domestic and anchor currencies.[6] This framework is clearly inadequate in

---

[5] The operation of interest rate arbitrage is similar to that of a currency carry trade, in which an investor sells a currency with a relatively low interest rate and uses the funds to purchase a different currency yielding a higher interest rate. This strategy attempts to capture the difference between the rates of the two currencies provided that their exchange rate is stable.

[6] The fixed exchange rate system is similar to the gold standard in which gold (reserves) is the money supply. It is important to note that gold should demand the same value everywhere. Bordo (1984) argues that: "a gold discovery in one country would lead to an increase in its money supply, an increase in its

answering the question mentioned above. Only when Krugman (1991) presented the first target zone model with explicit rational expectations for the nominal exchange rate in a small open economy, researchers started to rigorously model and understand the details of exchange rate determination and associated interest rate dynamics within an explicit target zone.[7] Based on the Krugman model, Svensson (1991a, 1991b) finds that a narrow target zone differs from a completely fixed exchange rate in that the interest rate differential's instantaneous standard deviation is high. Considerable uncertainty in the short-term interest rate is thus anticipated, whereas there will be much less uncertainty in the longer term interest rate. The implications of this for the term structure of interest rates in a target zone are consistent with empirical evidence. Froot and Obstfeld (1991) demonstrate that a regime change occurs in the exchange rate dynamics when a monetary authority allows its currency to move within a currency band instead of a fixed exchange rate.

In the Krugman model, a Brownian motion with a reflecting boundary condition at the upper and lower limits can be used as the driving process to keep the exchange rate within the zone under a symmetric mean-reverting process towards the central parity.[8] The exchange rate is thus expected to have a long-run equilibrium level around the central parity. However, given the strong demand for HKD driven by real transactional need, there is a forward premium on the HKD relative to the USD resulting in a negative interest rate differential, such that the equilibrium exchange rate is not necessary at the central parity of 7.8. When the exchange rate is "well within" the band, market participants behave as if they are in a comfort zone and do not feel particularly compelled or encouraged to pull the exchange rate towards its central parity. Such a long-run equilibrium exchange rate is determined by market expectation on real demand for the HKD, which is time-varying. In turn, this is reflected by the forward exchange rate implied by the forward premium.[9] The process of narrowing (or widening) the gap between the spot and equilibrium exchange rates depends on both the actual and expected demand for HKD.[10]

---

price level, and a fall in the domestic market price of gold. The divergence between the domestic and world gold prices would quickly lead to a gold outflow, a contraction in the domestic money supply, and a fall in the domestic price level." Capital inflows are similar to a gold discovery such that the domestic interest rate with a fixed exchange rate will fall and then increase according to the changes in money supply – resulting in zero interest rate differentials. See also footnote 14 below.

[7] The Krugman model is based on theories in monetary economics including the existence of a money demand function, the purchasing power parity and the uncovered interest rate parity. The theories form a flexible-price model of exchange rates.

[8] The driving force behind this mean-reverting property has been widely debated. Many empirical studies attempt to investigate this theoretical prediction by examining the time-series properties of the currencies within the European Exchange Rate Mechanism. However, the results are mixed, perhaps reflecting that the assumption of the equilibrium exchange rate at the central parity is not valid.

[9] The relationship between the forward premium and interest rate parity is expressed as:

$$FP = S - \frac{S(1+rt)}{(1+r^*t)},$$

where FP is the forward premium, S is the spot exchange rate (HKD/USD), r and r^* are the HKD and USD interest rates respectively, and t is the time horizon.

[10] Market frictions may also play a role in the process, but are not captured by the model here.

To investigate how money demand affects the exchange rate dynamics and interest rate differential, Lo, Hui, Fong and Chu (2015) extend the Krugman model by incorporating asymmetric mean-reverting fundamental dynamics. The extended model determines the exchange rate dynamics and its equilibrium level under a credible target zone system, where the demand for the currency is incorporated into the economic fundamental.[11] Their empirical results using the exchange rate data suggest the proposed target zone model can describe the HKD exchange rate dynamics during the period May 2005 – December 2013, in which the estimated equilibrium exchange rate is time-varying, and the increase in the MB through triggering the strong-side CU enhanced the stability of the exchange rate at the equilibrium level which is weaker than the strong-side CU rate of 7.75.

2.2 Interest rate differential and exchange rate movements

The theoretical interest rate differential derived from Lo et al. (2015) shows that it depends on the relative positions of the spot exchange rate and the equilibrium level which is determined by demand for the HKD, i.e., the fundamental in the economy. When the equilibrium level of the exchange rate moves close to the strong edge of its band due to strong demand for the HKD (capital inflows), the spot rate will move towards, but remain weaker, than the equilibrium level. Expectations of such movement within the band will decrease HKD interest rates below USD interest rates (i.e., a forward premium on the HKD and negative interest rate differential). Demand for the currency in foreign exchange markets is often judged by quotes in the forward market, as the forward rate should reflect market participants' expectations of the payoff probability of the trade and the most likely value of the future spot rate, leaving aside the possibility of risk premium. But that does not mean they are betting on an appreciation of the HKD as such. This suggests that under the mechanism of arbitrage, traders pick up the interest rate differential or forward point for profit making purposes. Conversely, a positive interest rate differential is expected when the equilibrium level is weaker than the spot rate.

The theoretical interest rate differential illustrated in Chart 2 based on Equation 28 in Lo et al. (2015) shows that the relative position of the spot and equilibrium exchange rates determines the sign of the interest rate differential. In other words, the theory allows both positive and negative interest rate differentials to appear in the entire Convertibility Zone.[12] This is consistent with the observations in Chart 3 which presents the HKD spot exchange rate against the 12-month HIBOR-LIBOR since 2008, along with the corridor (upper and lower bounds) implied by the interest rate parity allowing that the width of 1000 pips of the Convertibility Zone can at most accommodate the 12-month interest rate spread of +/-130 bps.[13] For example, the interest rate differential was

[11] The fundamental could be a combination of the foreign and domestic money supplies, real incomes, money demand disturbance and real exchange rate movements.

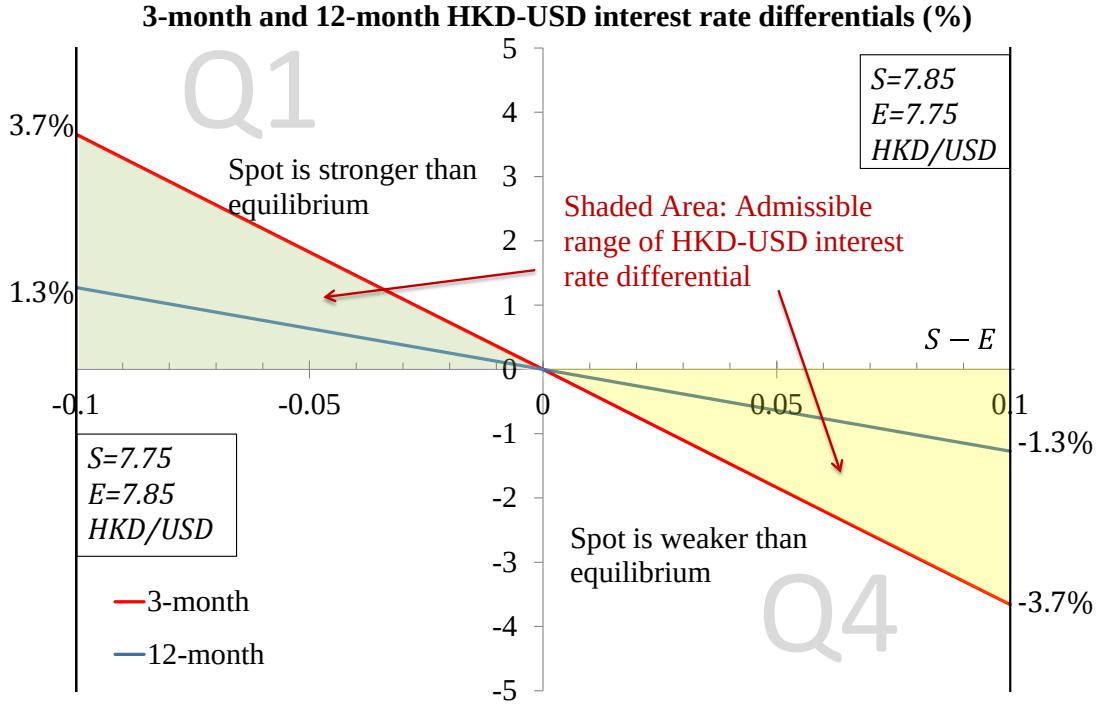
[12] Lo et at. (2015) and Hui, Li and Lo (2017) show that the theoretical interest rate differential can explain the market HKD-USD interest rate differential during 2008 – 2017.

[13] It is assumed that both exchange rate risk premium and transaction costs are zero.

negative when the spot rate was at the weak side of the Convertibility Zone (the brown dots in the Q4 quadrant of Chart 3) during 2017-18.

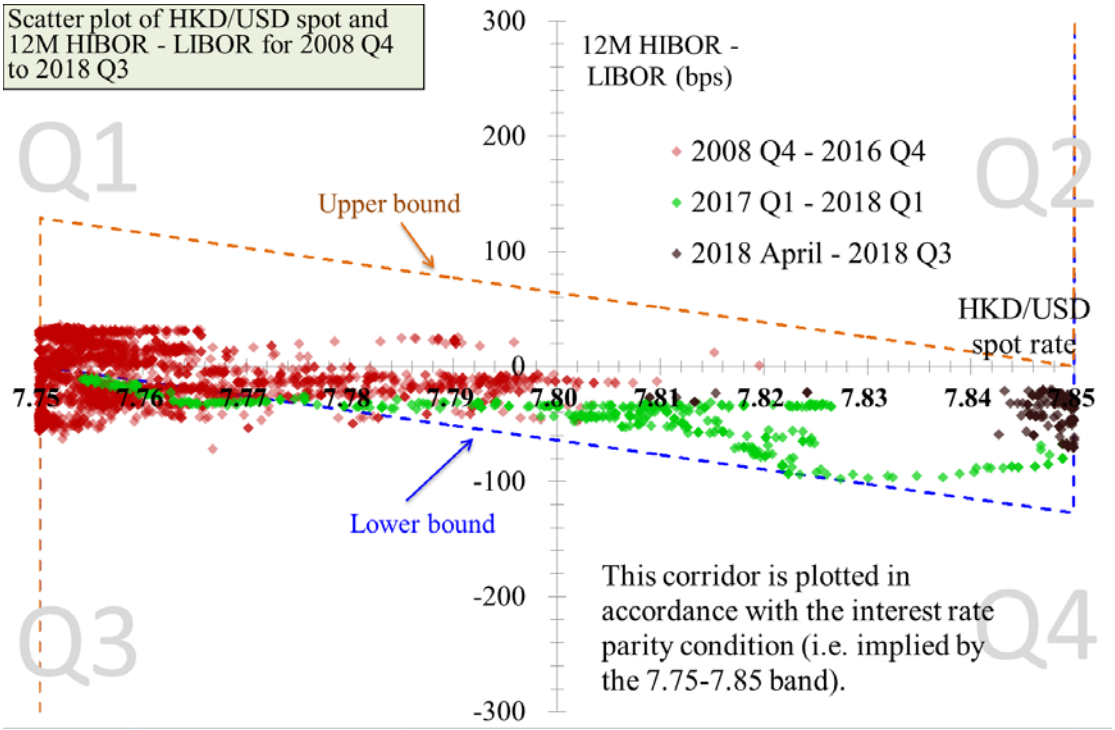
According to the theory, such observations suggest that the equilibrium exchange rate was stronger than the spot rate during that period (the yellow-shaded area in Chart 2). On the other hand, the positive interest rate differential is found during 2008-2016 when the spot rate was at the strong side (the red dots in the Q1 quadrant of Chart 3) – suggesting the equilibrium exchange rate was weaker than the spot rate (the green-shaded area in Chart 2).[14] The term structure of the interest rate differentials in Chart 2 decreases with the time to maturity, which is consistent with the empirical observations (as shown in Chart 4 in the next section) and the findings in Svensson (1991a, 1991b).

Chart 2: Theoretical HKD-USD interest rate differential of relative spot (*S*) and equilibrium (*E*) exchange rates based on Equation (28) and empirical estimations in Lo et al. (2015) with different time-to-maturity



[14] According to the theory of completely fixed exchange rates, in which only interest rate arbitrage plays the role for the exchange rate dynamics given that the interest rate differential must be zero in equilibrium, the differential should be positive in a short run when the spot exchange rate is at the weak side of the Convertibility Zone. Similarly, only the negative interest rate differential is allowed when the spot rate is at the strong side. However, such theory is not applicable to a target zone and not supported by the empirical evidence shown in Chart 3.

Chart 3: 12-month HIBOR-LIBOR differential within the range implied by the 7.75-7.85 band



The negative interest rate differential induces interest rate arbitrage, therefore generating offsetting capital flows by market participants selling HKD in exchange for USD. The interest rate gap will thus be narrowed accordingly. However, if the arbitrage of selling HKD is not sufficiently strong to offset the capital inflows, the HKD interest rate will decline further. The negative values of the interest rate differentials at ($S - E = 0.1$) shown in the yellow-shaded area of Chart 2 are the theoretical lower bounds at different time-to-maturity when the strong-side CU could be triggered. When the interest rate differentials touch the lower bounds or the HKD interest rates lower to zero, demand for the HKD will trigger the strong-side CU. This mechanism manifests itself when the USD interest rate is close to the zero lower bound and the demand for HKD is strong. While capital flows into the HKD, there is no depressing effect on the HKD interest rate, which is constrained by the zero lower bound.[15] In other words, the effect of interest rate differentials is limited when interest rates are close to the zero lower bound. As a result, the inflows cause foreign reserves (i.e., the MB) and the corresponding HKD liquidity to increase.[16] Lo et al. (2015) show that the increase in the MB due to capital inflows into the HKD pushes the exchange rate back to its equilibrium level and stabilises the movement of the spot exchange rate away from the strong-side CU.

[15] Although nominal interest rates can be negative when central banks adopt a negative interest rate policy, such policy has not been in place for Hong Kong and the US. Hence, the zero lower bound of interest rates remains a constraint for the HKD.

[16] Cook and Yetman (2014) introduce a new mechanism that works through the central bank balance sheet which helps to bring about equilibrium in currency markets even when interest rates are zero.

With a material negative interest rate differential and reduced demand for HKD, the associated interest rate arbitrage could push the spot exchange rate towards the weak side of the Convertibility Zone. In theory, the equilibrium exchange rate which reflects the expected HKD demand could remain stronger than the spot exchange rate, i.e., keeping a forward premium on the HKD and negative interest rate differential. The mechanism and theory thus suggest that a positive interest rate differential is not a necessary condition for the exchange rate staying at the weak side of the Convertibility Zone (see the brown and green dots in Q4 of Chart 3).[17] This also suggests that the negative interest rate differential could be persistent given that the gap between the spot and equilibrium exchange rates could be narrowed slowly under the mean-reverting exchange rate dynamics which is determined by money demand.[18]

The arbitrage process could eventually push the exchange rate towards the weak-side limit and trigger the weak-side CU, i.e., capital outflows with a reduction in the MB. Depending on the real HKD demand, the corresponding reduction in HKD liquidity (increases in HKD interest rates) would reduce the incentive for interest rate arbitrage and push the exchange rate back to the equilibrium level which is stronger than the weak-side CU rate of 7.85. Given that capital flows will first change the amount of the Aggregate Balance in the MB, the effects of such changes on the exchange rate and HKD interest rates are discussed in the next section.

Conversely, a positive interest rate differential could offset capital outflows by market participants buying HKD, and the interest rate gap will narrow accordingly. However, if the arbitrage of buying the HKD is not sufficiently strong to offset the capital outflows, the HKD interest rate will increase further and the weakened demand for HKD may trigger the weak-side CU. The positive values of the interest rate differentials at ($S - E = -0.1$) shown in the green-shaded area of Chart 2 are the theoretical upper bounds at different time-to-maturity for triggering the weak-side CU. Similar to triggering the strong-side CU, the reduction in the MB due to capital outflows from the HKD pushes the exchange rate back to its equilibrium level and stabilises the movement of the spot exchange rate away from the weak-side CU.

When there is no triggering of the CU, the exchange rate could move within the zone according to the actual demand for HKD and interest rate arbitrage. The anticipated marginal CUs still affect exchange rate movements near the margins, reflecting that the LERS is credible. In the next section, after studying the LERS during the period 2008–2018, when there were significant capital inflows and subsequent outflows due to the US interest rate hikes, our empirical evidence illustrates how the mechanism has operated , suggesting that the LERS is a robust target zone system.

---

[17] Given that the exchange rate is expected to move towards a stronger equilibrium level under the mean-reverting dynamics, this demonstrates the LERS is credible.

[18] Lo et al. (2015) and Hui, Li and Lo (2017) show empirically that the HKD exchange rate dynamics follows the mean-reverting stochastic process according to their target zone model.

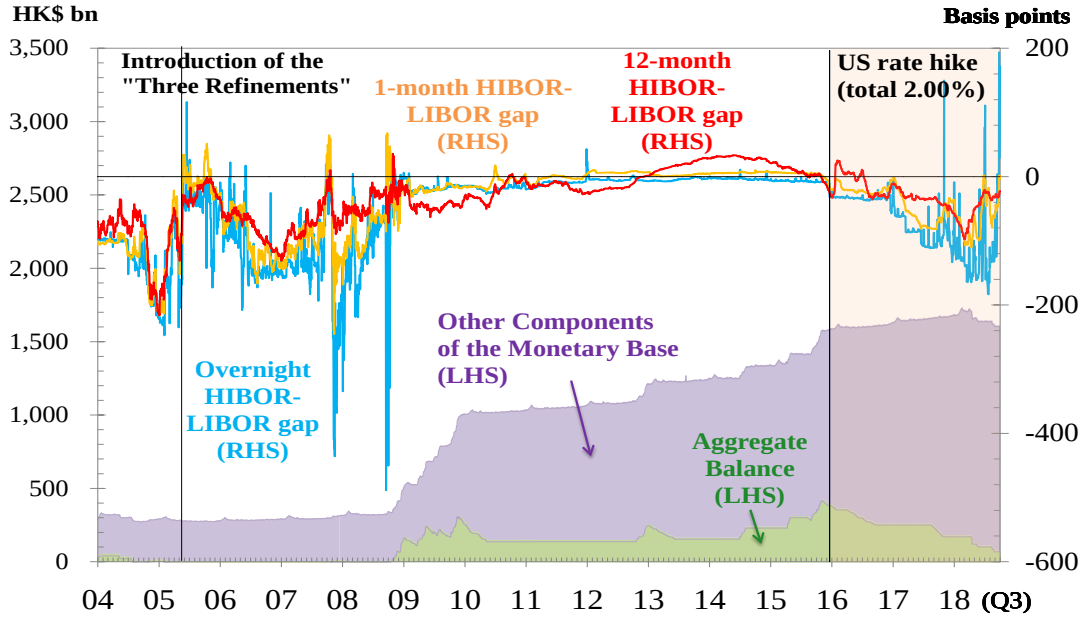
III EFFECTS OF THE LERS OPERATIONS ON FOREIGN EXCHANGE AND INTEREST RATE MARKETS

This section presents empirical evidence to illustrate how the LERS operations affected the HKD foreign exchange and interest rate markets with the triggering of the strong- and weak-side CUs respectively. This was at the time when both the HKD and USD interest rates were at the zero lower bound between 2009 and 2015, and the Fed had begun raising interest rates from December 2015. The evidence demonstrates that the HKD exchange rate and interest rate differential dynamics are consistent with the mechanism and theory of the LERS operations.

3.1 LERS operations and triggering of strong-side CU during 2009-2015

Charts 1 and 4 illustrate the evolution of the HKD/USD spot exchange rate, HIBOR-LIBOR spreads, MB and Aggregate Balance since the "three refinements" for the LERS. The blue-shaded and red-shaded areas in Chart 1 represent the triggering of the strong- and weak-side CUs respectively. As both the HKD and USD interest rates approached the zero lower bound after the global financial crisis, their negative interest rate differentials narrowed considerably, which diminished the carry trade activities, and were unable to provide a counteracting force against the strong demand for HKD.[19] As a result, the HKD exchange rate strengthened considerably, with repeated triggering of the strong-side CU from late 2008 to 2015. The continuous inflows amounted to US$130 billion or HK$1 trillion given Hong Kong's stable banking system and positive outlook.

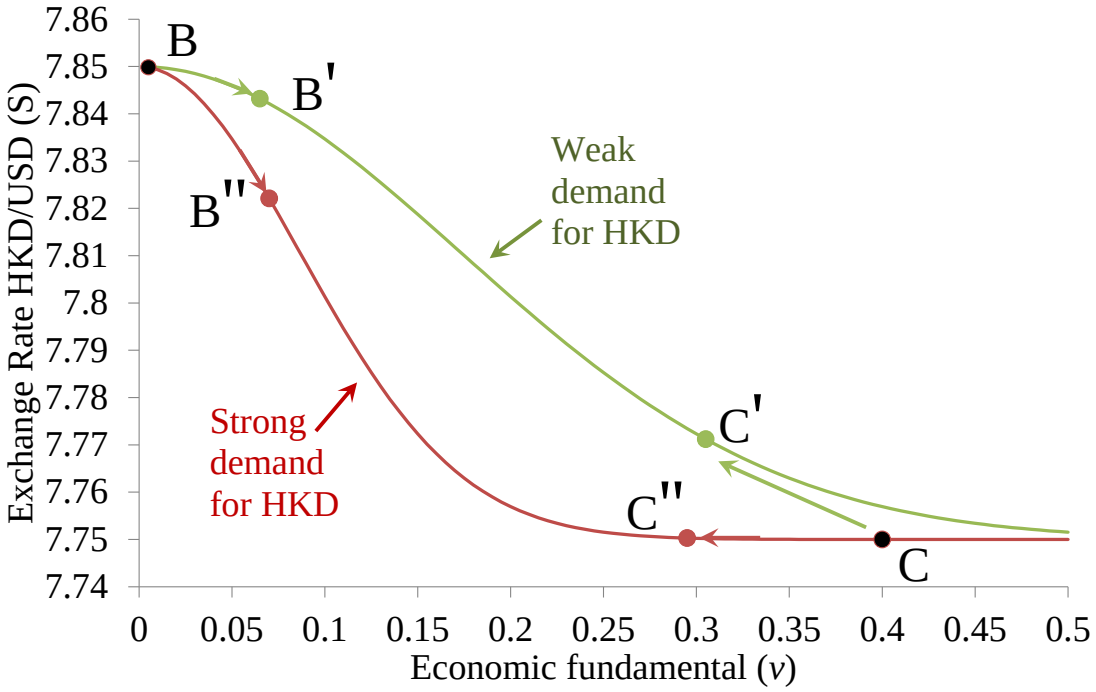
Chart 4: The HIBOR-LIBOR spread, Monetary Base and Aggregate Balance



[19] The negative spread between the one-month HIBOR and LIBOR decreased from over 200 bps at the end of 2007 to around 20 bps in mid-2009.

The exchange rate was quite sticky at the strong-side CU during 2009 and again between 2013-2015. Chart 5 plots the theoretical relationship between the exchange rate and the economic fundamental for the HKD. It shows that changes in the exchange rate flatten with changes in the fundamental at the strong- and weak-side CU rates compared to positions near the central parity of 7.8. This means the exchange rate could marginally move away from 7.75 even though the fundamental changes materially. Lo et al. (2015) find that when capital inflows push the HKD exchange rate towards its strong-side limit, there is a counteracting tendency of a mean reversion back to the equilibrium level which acts as a stabilising force to limit further appreciation of the HKD. A wide enough interest rate differential also induces selling pressure on the HKD from carry trades. Chart 1 demonstrates that the HKD exchange rate eventually weakened after repeated triggering of the strong-side CU and moved away from 7.75 in early 2010 amid the negative interest rate differential. The empirical observations are thus consistent with the theory and mechanism of the LERS. In theory, as capital flows change the economic fundamental, the exchange rate could move from C (7.75) to C" or C' (i.e., away from 7.75) as shown in Chart 5, where the paths depend on strong or weak demand for the HKD.

Chart 5: Relationship between the exchange rate (*S*) and economic fundamental (*v*) based on Equation (21) and empirical estimations in Lo et al. (2015), with different degrees of demand for HKD



3.2 LERS operations during US interest rate hikes and triggering weak-side CU

Although the Fed started the rate hike cycle in December 2015, the strong demand for HKD prevented the HKD interest rates to rise as much as their USD counterparts and led to a widening of the negative interest rate differentials. However, the widening of the spread was not large enough to induce sufficient carry trades to exert downward pressure on the HKD exchange rate.[20] After pausing for a year, the Fed resumed its rate hikes in December 2016 and its policy target reached 2% – 2.25% in September 2018. The negative interest rate differential eventually attracted more selling pressure on the HKD from carry trades and pushed the exchange rate towards 7.85. The weak-side CU was triggered on 12 April 2018 for the first time since it was set at this level in May 2005.

The weak-side CU was triggered repeatedly in April, May and August 2018, resulting in the HKMA purchasing a total of HK$103.5 billion from the market under the weak-side CU by the end of August. The Aggregate Balance has subsequently reduced to HK$76.6 billion, creating a more conducive environment for the normalisation of HKD interest rates. As HKD interest rates head higher, the negative interest rate spreads narrow, slowing down capital outflows and maintaining the stability of HKD exchange rate within the band. The brown dots in Chart 3 show that the pairing of the interest rate differential and the HKD exchange rate has remained within the theoretical corridor since triggering the weak-side CU in April 2018.[21] The fact that the HKD spot exchange rate remains at the weak-side of the Convertibility Zone (and weaker than the equilibrium exchange rate resulting in the negative interest rate differential as shown in Charts 3 and 4) is again consistent with the theory presented in Chart 2.

Chart 1 shows the HKD exchange rate was quite sticky near 7.85 after triggering the weak-side CU, but moved sharply at the end of September 2018.[22] In theory, Chart 5 suggests that the exchange rate could move from B (7.85) to B' or B'' with the changed economic fundamental after triggering the weak-side CU. The path to B'' (strong demand for HKD) allows a relatively sharper exchange rate movement than that to B' (weak demand for HKD) given the same change in

---

[20] The HKD exchange rate moved sharply from 7.75 towards 7.8 in January 2016 (see Chart 1) mainly due to the short-lived turmoil in the exchange rate markets of some emerging economies.

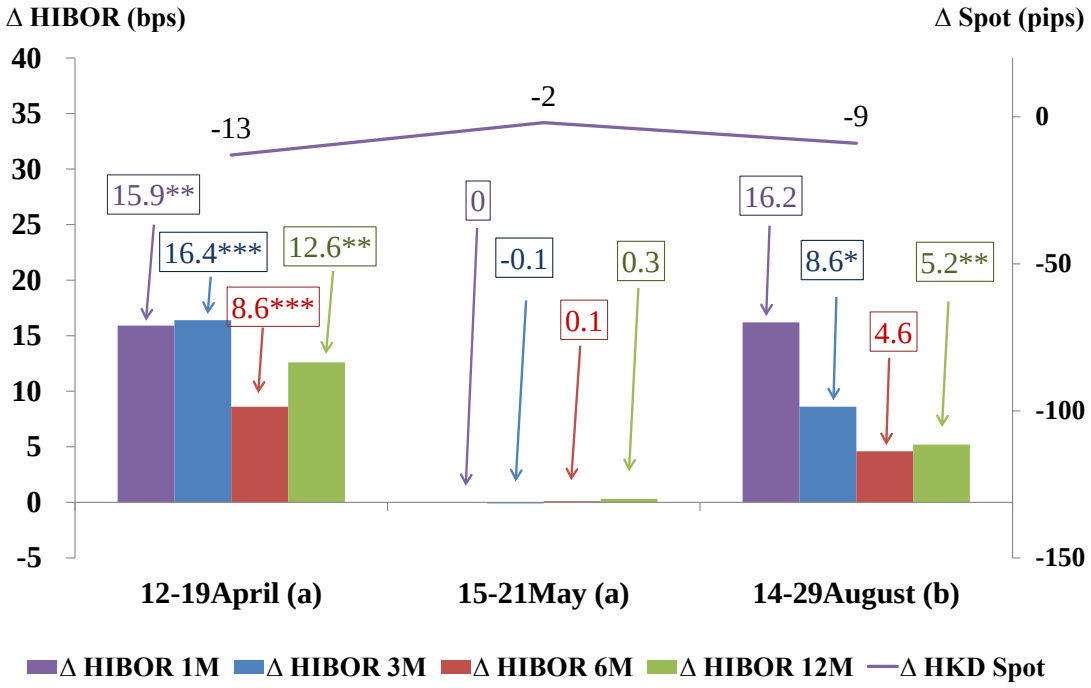
[21] Taking into account factors such as bid-offer, credit limits, market/regulatory frictions and the fact that some parties will not convert their HKD into USD because of transactional needs, the HIBOR-LIBOR gap could, in practice, be wider than the range implied by the 7.75-7.85 band. While these factors cannot be quantified, the deviations as shown in Figure 3 are relatively small and came during the period of both HKD and USD interest rates at the zero lower bound which might cause higher market risk premiums for the transactions.

[22] It is generally considered that the rising HKD short-date interest rates along with the unwinding of the massive carry trade position are the main drivers behind the strengthening of the HKD at the end of September 2018.

the fundamental.

An event study is conducted for the weak-side CU being triggered with the purchase of HK$51.3 billion, HK$19 billion and HK$33.1 billion during April, May and August 2018 respectively to investigate the effects of the operations on the HKD exchange rate and interest rates. The estimations follow the approach in Swanson (2011) by examining the changes in HIBORs and the HKD exchange rate around the dates of the weak-side CU being triggered. [23,24] The operations of purchasing HKD during April, May and August 2018 are grouped into three events with the cumulative changes in the HIBORs and the exchange rate in the study. The results in Chart 6 reveal that triggering the weak-side CU led to significant changes in both HIBORs across different maturities and the strengthening of the HKD exchange rate during the April and August operations.[25] However, the effects of the May operations were insignificant, probably due to the relatively small size of the operation.

Chart 6: Changes in HIBORs (bps) and HKD/USD spot exchange rate (pips) under triggering of the weak-side CU in April, May and August 2018



[23] A one-sided t-test was applied for testing the null hypothesis that the announcements had no effect on the variables of interest. The standard deviation used in the t-test is calculated from a 60-day sample of daily price change prior to each announcement. By measuring price changes in a narrow window, this methodology neglects the potential delayed but long-lasting effects.

[24] Using daily data, a narrow one-day event window constructed around the announcement time allows us to treat other financial market factors as roughly constant, which can better identify the effect of the operations. As a robustness check, an event study of a 2-day window is also conducted and the results are found to be quantitatively similar.

[25] The stabilisation of the HKD exchange rate was attributable to both expectations that higher rates would close arbitrage windows and increase HKD demand ahead of a heavyweight initial public share offering (IPO). As stated earlier, the event study was unable to isolate the impacts of the heavyweight IPO from the impacts of the weak-side CU operations.

Note: (a) *, ** and *** indicate 10%, 5% and 1 % level of statistical significance relative to the prior 56 (57) days' 5-day (4-day) variations before 12April2018 (15May2018, excluding those days during 1st round of weak side CU triggering) respectively. 1-sided t-tests are conducted for the HIBOR fixing and HKD/USD spot rate based on the hypothesis [H0: Change in HIBOR (bps) = 0 versus H1: Change in HIBOR (bps) > 0] and [H0: Change in HKD/USD spot (pips) = 0 versus H1: Change in HKD/USD spot (pips) < 0].
(b) The triggering of the weak-side CU occurred on five non-consecutive days during 14-29August and cumulative impacts of the five corresponding 1-day changes were reported here. The standard deviations for the cumulative 5-day changes are derived in a manner similar to Swanson (2011). Other details of the t-tests are similar to those stated in (a).
Sources: Bloomberg; HKMA staff estimates.

Triggering the weak-side CU suggests that demand for the HKD has reduced and the equilibrium exchange rate has weakened towards the spot exchange rate near 7.85, according to the theory. As shown in Chart 2, such exchange rate dynamics narrows the interest rate differential. The diminished carry trade incentive will eventually bring the HKD exchange rate away from 7.85 along the paths shown in Chart 5 as the economic fundamental changes.

IV CONCLUDING REMARKS

Hong Kong's LERS has been operating successfully under the objectives of the monetary policy consistent with the Currency Board principles for the past 35 years. One important reason for its longevity is due, in part, to its rules-based nature and to the fact that refinements have made it less discretionary over time. This paper investigates this argument again by studying the operations and mechanism of the LERS since 2008 when the system experienced both capital inflows and outflows.

The results indicate that the system has been working according to its design and consistently with the recently developed target zone model, which can adequately describe the exchange rate dynamics and its associated interest rate differential in a credible target zone. They explain the sticky exchange rate dynamics near the CU rates (7.75 and 7.85) and the persistent negative interest rate differential present in the entire Convertibility Zone. This addresses how the design of the LERS differs from a completely fixed exchange rate regime. The effects of the weak-side CU on the HKD exchange rate and interest rates are further discussed through an event-study analysis. Overall, our findings suggest that making the policy environment less discretionary does have benefits in terms of increased credibility and hence greater robustness.[26]

[26] John Greenwood recently acknowledged "… it is better that the HKMA preserve and enhance the HKMA's credibility by observing the 'rules' of the Currency Board system. The best way to do that is to operate the 7.75-7.85 band mechanism based on transparent rules that everyone can understand, not based on discretion". See "Rules versus Discretion in Managing the HK$ Peg" at https://hk.finance.appledaily.com/finance/daily/article/20180502/20379066

REFERENCES

Bordo, M. D. (1984). The gold standard: The traditional approach, in M.D. Bordo and A. J. Schwartz (eds), A retrospective on the Gold Standard, *NBER Conference Report, Chicago*, Chicago University Press, pp. 23-113.

Cook, D., & Yetman, J. (2014). Currency boards when interest rates are zero. *Pacific Economic Review*, 19, pp. 135–151.

Froot, K. F., & Obstfeld, M. (1991). Stochastic process switching: Some simple solutions, *Econometrica*, 59, pp. 241–250.

Genberg, H., & Hui, C. H. (2011). The credibility of Hong Kong's Link from the perspective of modern financial theory. *Journal of Money, Credit and Banking*, 43, pp. 185–206.

Hui, C. H., Li, K. F., & Lo, C. F. (2017). Exchange rate dynamics under a currency board when policy rates are zero. *Hong Kong Institute for Monetary Research*, WP No.12/2017.
Krugman, P. (1991). Target zones and exchange rate dynamics. *Quarterly Journal of Economics*, 106, pp. 669–682.

Lo, C. F., Hui, C. H., Fong, T., & Chu, S. W. (2015). A quasi-bounded target zone model – Theory and application to Hong Kong dollar. *International Review of Economics and Finance*, 37, pp. 1–17.

Svensson, L. E. O. (1991a). Target zones and interest rate variability. *Journal of International Economics*, 31, pp. 27–54.

Svensson, L. E. O. (1991b). The term structure of interest rate differentials in a target zone: Theory and Swedish data. *Journal of Monetary Economics*, 28, pp. 87–116.

Swanson, E. T. (2011). Let's twist again: A high-frequency event-study analysis of operation twist and its implications for QE2. *Brookings Papers on Economic Activity*, Economic Studies Program, The Brookings Institution, vol. 42(1 (Spring), pp. 151–207.