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The credibility of *The Link* from the perspective of modern financial theory*

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Abstract

Hong Kong's Linked Exchange Rate System (LERS) has been in operation for twenty-five years during which time many other fixed exchange rate systems have succumbed to shocks and/or speculative attacks. This fact alone suggests that the LERS is a robust system which enjoys a large measure of credibility in financial markets. This paper intends to investigate whether this is indeed the case, and whether it has been the case throughout its 25-year history. In particular we will use the tools of modern finance to extract information from financial asset prices about market expectations that are related to the credibility of the LERS. The main focus is on how market participants 'judged' the various changes made to the LERS, such as the 'seven technical measures' introduced in September 1998 and the 'three refinements' made in May 2005. These changes have been characterizes as making the system less discretionary over time, and we hypothesize that they have also made it more credible as revealed in the prices of exchange rate related asset prices. We also investigate the relationship between interest rates and exchange rates in the current system in light of modern models of target-zone exchange rate systems. We will examine whether the intra-marginal intervention in November 2007 changed the dynamic properties of the exchange rate as suggested by such models.

I. Introduction and summary.

Hong Kong's Linked Exchange Rate System (LERS) has been in operation for twenty-five years during which time many other fixed exchange rate systems have come and gone, succumbing to shocks and/or speculative attacks. This fact alone suggests that the LERS is a robust system which enjoys a large measure of credibility in financial markets. This paper intends to investigate whether this is indeed the case, and whether it has been the case throughout its 25-year history. In particular we will use the tools of modern finance to extract information from financial asset prices about market expectations that are related to the credibility of the LERS. The main focus is on how market participants 'judged' the various changes made to the LERS, such as the 'seven technical measures' introduced in September 1998 and the 'three refinements' made in May 2005. These changes have been characterized as making the system less discretionary over time,[1] and we hypothesize that they have also made it more credible in the eyes of financial market participants.[2]

We will define credibility with reference to the behaviour of asset prices, principally nominal interest rates, the US dollar exchange rate and various derivative products related to these underlying instruments. Our strategy is to attempt to infer from asset prices how market participants judged reforms of the system and its future. We do so in part by extracting information about exchange-rate expectations from market prices, in part by investigating exchange-rate and interest-rate volatility, and in part by studying the dynamics of the exchange rate itself. To place the empirical analysis in context, we start in the next section by recalling the main features of the LERS, highlighting how the nature of the official exchange rate commitment evolved over time and outlining the main features of refinements that were introduced. In section III we implement a recently developed technique for estimating the distribution of exchange rate expectations from market prices and use the results to investigate how this distribution changed around the times of significant changes in the LERS. We find that, generally speaking, the two major

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[1] Latter (2007a).
[2] Kwan et al. (1999) employ a number of methods developed in the target zone literature to measure the credibility of Hong Kong's currency board during the Asian financial crisis in 1997-8.

changes in the exchange rate aspects of the system, the 'seven technical measures' and the 'three refinements' achieved their goals of reducing uncertainty about the future value of the exchange rate and can therefore be said to have increased the credibility of the system. Furthermore, the effects of the announcements were reflected rapidly in market prices.

In section IV we study the evolution over time of the volatility of the exchange rate and the interest rate differential between HKD and USD instruments. It is frequently suggested that fixing the exchange rate, i.e. reducing its volatility, will come at the expense of increased interest rate volatility because the central bank will need to adjust the interest rate in response to pressures in the foreign exchange market. This, however, need not be the case if the fixed exchange rate is perfectly credible, because in this case excess demand for foreign exchange by some market participants will be offset by opposite positions taken by other participants who have confidence that the exchange rate peg will be maintained. Our results show that volatility in both the exchange rate and interest rates declined after the introduction of the seven measures and spill-overs from exchange rate volatility to interest rate volatility was reduced. The evidence relating to the three refinements is less clear-cut, but volatility in the money and foreign exchange markets were much lower in the most recent period of the system than before the seven measures.

In section V we turn our attention to the period after the latest refinements of the LERS in May 2005 which established a symmetric band for the HKD/USD exchange rate around 7.8. We investigate the properties of the movements of the spot exchange rate within the band, in particular whether they are mean reverting and bounded - which would indicate that markets believe the Link to be maintained – whether they have been influenced by intra-marginal interventions by the Hong Kong Monetary Authority (HKMA). We also discuss the influence of a more flexible renminbi exchange rate on both interest-rate and exchange-rate movements in Hong Kong, and relate it to a 'puzzle' in the Hong Kong dollar forward market where the forward exchange rate at times have been outside the intervention limits implied by the current version of the LERS. Our conclusions again imply that market prices generally suggest that the Link is viewed as a credible system by

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market participants.

In the final section of the paper we draw together our conclusions and speculate about the broader reasons for the main results that we find, namely that the credibility of the LERS as revealed by asset prices seems to have increased over time.

II. A brief history of the LERS.

The evolution of the monetary system in Hong Kong since 1983 has been thoroughly described and analysed in recent works by John Greenwood and Anthony Latter and does not need to be repeated here.[3] Instead we highlight only those events that are most directly related to our evaluation of how market participants reacted to the changes in the system that were introduced over time.

The exchange rate commitment.

The LERS was introduced in October 1983 with a fixed exchange rate between a certificate of indebtedness (CI) and the US dollar at the rate of 7.8 HKD/USD. Holding CIs gave the note issuing banks the right to issue Hong Kong dollar (HKD) bills. Hence the fixed value of the CI effectively translated into a fixed exchange rate between the HKD and the USD for currency transactions. Although, as we shall see, the system has undergone a number of modifications since then, this fixed rate between the CI and the USD has never been changed as illustrated by the light blue line in Chart 1.

Although in theory an exchange rate commitment involving only currency might through arbitrage also lead to a convergence between the exchange rate in the interbank market and the fixed rate for currency, this did not happen in practice. A wider exchange rate commitment for reserve balances of banks - Authorized Institutions, or AIs, as they are referred to – was therefore introduced in September 1998 at the rate of 7.75 HKD/USD. This was a weak-side commitment in that the HKMA was ready to purchase

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[3] See Greenwood (2008) and Latter (2007a,b). Both authors have been close observers of monetary affairs in Hong Kong during this period, Greenwood as a private sector economist and, since 1998 member of the Currency Board Subcommittee of the Exchange Fund Advisory Committee, and Latter as Deputy Secretary for Monetary Affairs in the Hong Kong government from 1982 to 1985 and as Deputy Chief Executive of the Hong Kong Monetary Authority from 1999 to 2003.

unlimited amounts of Hong Kong dollars for US dollars to prevent a weakening of the currency beyond that rate. No strong side commitment was introduced at that time. The weak side commitment was gradually moved from 7.75 to 7.8 between April 1999 and July 2000 as shown by the red line in the chart.

The exchange rate commitment was altered once again in May 2005 when a symmetric convertibility zone (or target zone to use the terminology of the academic literature) was introduced with a strong side Convertibility Undertaking (CU) at 7.75 HKD/USD (the black line in Chart 1) and the weak side CU gradually being gradually moved from 7.8 to 7.85 over a period of 5 weeks.

A question that we will investigate in Section III is how the change in the 'rules of the game' affected expectations in the foreign exchange market, in particular whether the mere announcement of the change had an impact, or whether it took some time for market participants to be convinced. We will also look at the implications of the introduction of the symmetrical target zone in 2005 for the dynamics of the exchange rate within the zone, specifically whether it conforms to the predictions of the theoretical literature on target zones.

The 'Accounting Rules' of July 1988.

During the first five years of operation of the LERS interbank clearing operations were carried out entirely in the private sector through banks' clearing accounts with the HSBC. There was no formal official involvement in the market and hence no possibility for the authorities to influence liquidity conditions in the interbank market by means of open market operations. This changed in July 1988 with the introduction of the 'accounting rules' which required the HSBC to hold reserve balances in an account with Exchange Fund. The size of the account should be no less than the net clearing balances of the rest of the banking system.

The significance of the new rules for our purposes was that the authorities now had the possibility to influence money market conditions directly making it possible for them to have an additional degree of control over interest rates and the exchange rate. Greenwood (2008), p. 214 notes

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that this gave the authorities more discretion to steer the markets in the direction they considered desirable. As the data necessary for carrying out our analysis only start in 1996 we are not able to assess the effect of this additional degree of freedom on the behaviour of market participants.

In December 1996 a RTGS system was introduced in Hong Kong and at the same time all AIs were required to hold reserve balances with the HKMA which had been established in April 1993. Again, due to data limitations we are unfortunately unable to assess whether these events had any material impact on the volatility of interest rates and exchange rates as well as on market expectations.

The 'Seven Technical Measures' of September 1998.

The financial crisis in East Asia in 1997 and 1998 provided the impetus for another modification of the LERS. The so-called 'seven technical measures' were introduced in September 1998 with the purpose of strengthening the system. For our purposes the two most significant features were (i) the introduction of the weak-side CU which has already been described above, and (ii) the introduction of a discount window facility which made it possible for banks to borrow from the HKMA against collateral. The objective of the latter was to dampen interest rate volatility that was very high during the crisis. (See Chart 1 for an illustration of the interest rate movements at the time.)

Did the seven technical measures instil greater confidence in the LERS and did they alter the volatility of the exchange rate and interest rates? Sections III and IV provide the answers.

The 'Three Refinements' of May 2005.

Starting in the fall of 2003 the Chinese renminbi came under pressure to appreciate. Judged by non-deliverable forward contracts on the CNY, market expectations indicated a steady increase in the expected appreciation of the Chinese currency. The Hong Kong dollar also came under pressure, perhaps due to expectations in the market that the Hong Kong authorities would follow any move by their counterparts on the Mainland to allow the currency to appreciate with respect to the USD. Two consequences materialized. First,

the HKD/USD spot rate started to appreciate (see Chart 1) and since the LERS did not contain an explicit strong side convertibility commitment there was considerable uncertainty about the extent of the appreciation that the HKMA would allow. Second, expectations of appreciation meant a forward premium on the HKD relative to the USD and therefore a negative interest rate differential. As US interest rates also were quite low at the time, HKD short-term interest rate declined to close to zero. (Chart 2)

The combination of very low interest rates, which risked creating overheating in the economy in general and in asset markets in particular, and increased uncertainty about the exchange rate level, which could call into question the credibility of the LERS, suggested the need for an official response. It came on May 19, 2005 in the form of 'Three Refinements' to the LERS. These were (i) the introduction of a strong side CU at 7.75 HKD/USD, (ii) moving the weak-side CU to 7.85 (in small steps over a 5 week period) thus creating a symmetric convertibility zone around 7.8, the convertibility rate for CIs which, as explained above, had been in effect since 1983, and (iii) giving the HKMA the possibility to intervene inside the convertibility zone
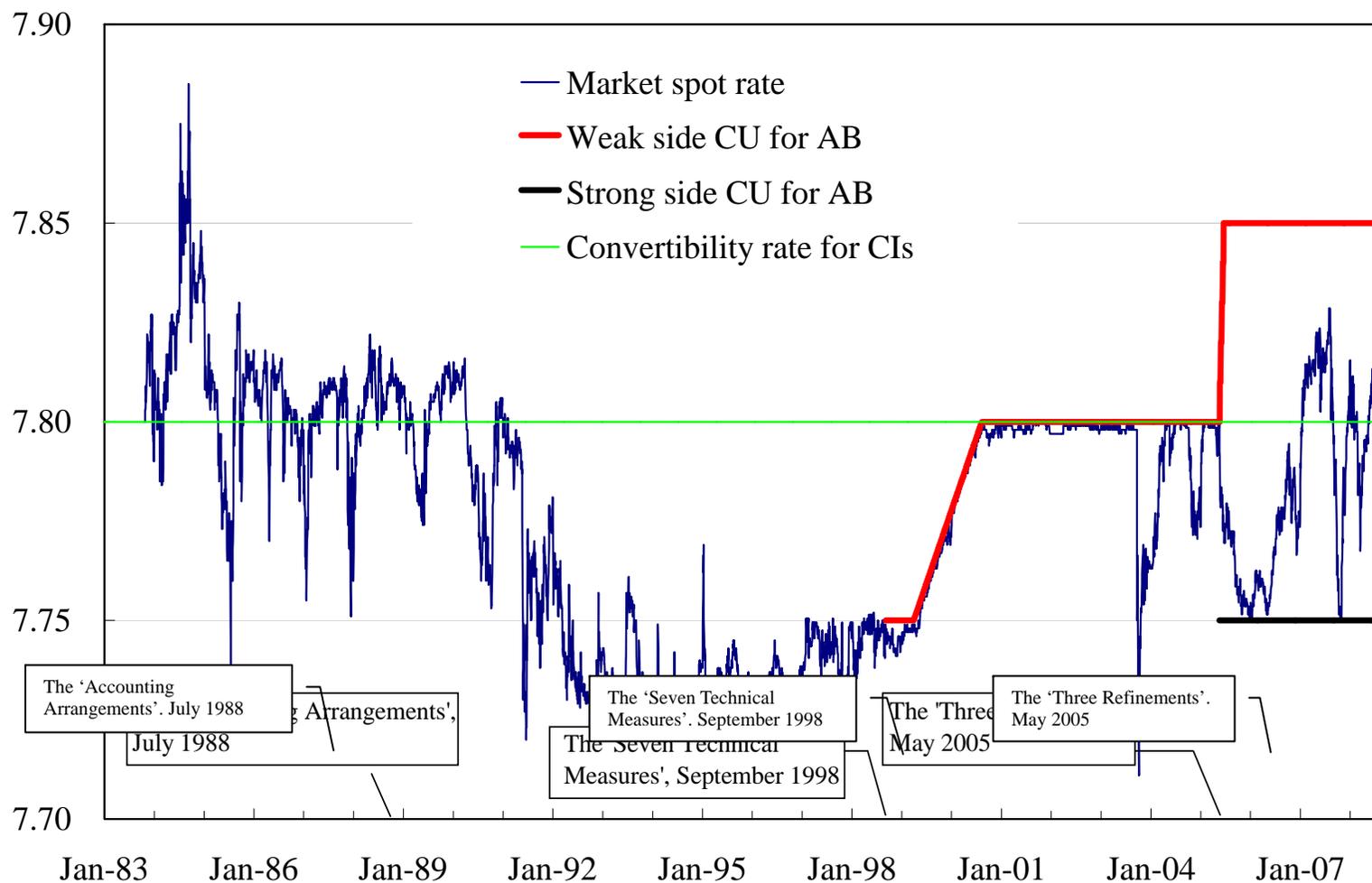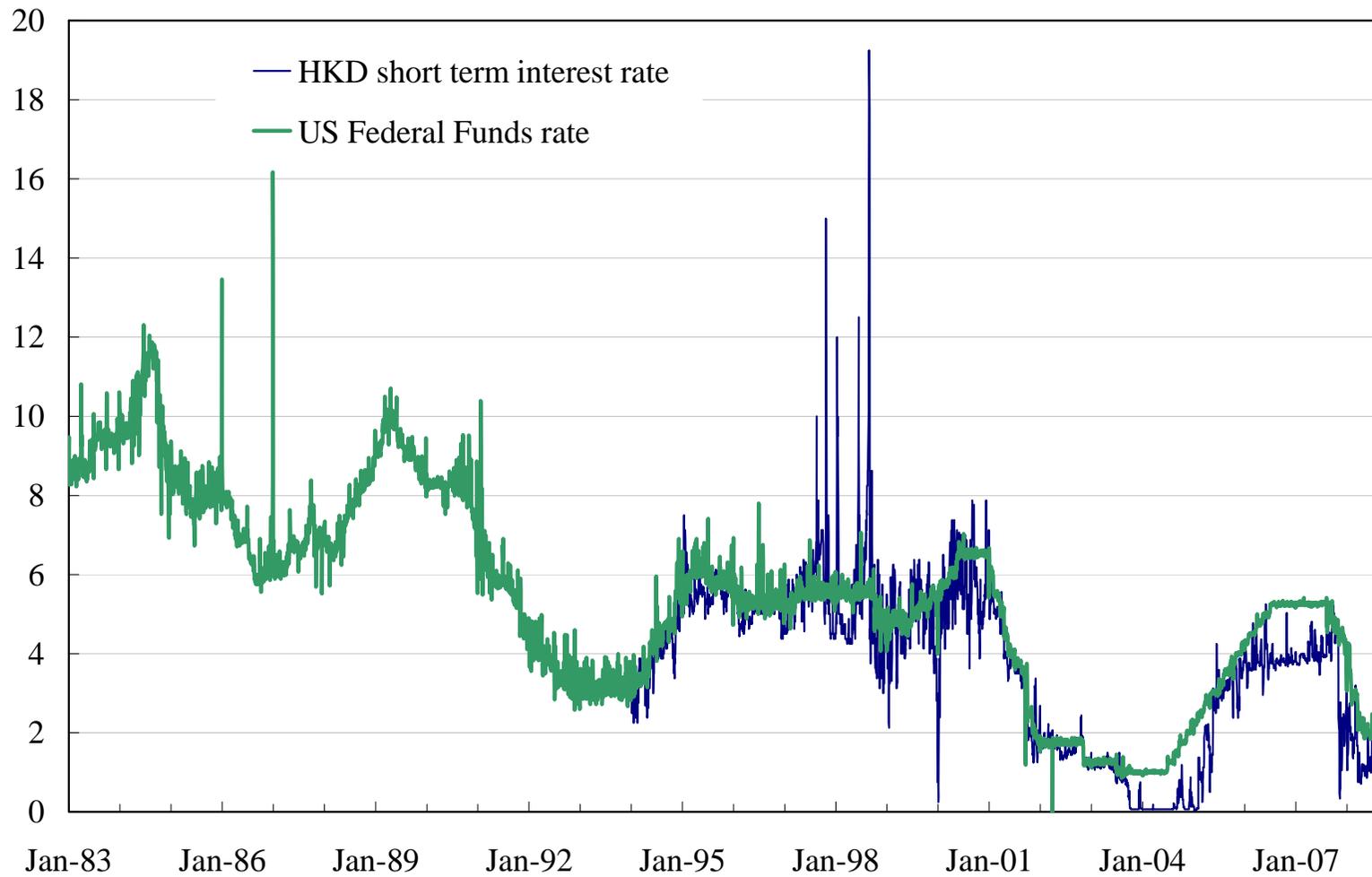
Chart 1:

Chart 2:

In addition to investigating how, and how fast, expectations of market participants reacted to the 'Three Refinements', in Section V we will study how exchange-rate and interest rate movements in the refined system compare with theoretical predictions of target-zone models of exchange rates. In particular we will ask whether the dynamics of the exchange rate was altered when the HKMA conducted its first – after the introduction of the three refinements - intramarginal intervention in the foreign exchange market in October 2007.

III. The reaction of market expectations to reforms of the system.

In this section we will use measures of exchange rate expectations derived from asset prices to infer how market participants assessed two reforms of the linked exchange rate system, 'the seven technical measures' introduced in September 1998 and 'the three refinements' of May 2005. Our main interest is to examine whether 'the market' seemed to have confidence in the promises made by the HKMA in each of these instances and, if so, whether this confidence was reached rapidly through the words of the Monetary Authority or had to be 'earned' over time through its deeds.

Expectations in foreign exchange markets are often judged by quotes in the forward market, as the forward rate should, leaving aside the possibility of risk premia, reflect market participants' expectations of the most likely value of the future spot rate. While having an estimate of the central tendency of expectations is useful for some purposes, in this section we are more interested in how refinements to the LINK affected the range of expectations. To this end we use two measures derived from prices of foreign exchange options: the implicit probability density function of exchange rate expectations, and an estimate the maximum depreciation or appreciation expected by the market over a given horizon.

A word of caution on the use of market prices to infer expectations of market participants. Just as the forward rate may be a biased estimate of the future spot rate because of risk premia, the measures we derive will only be as good as the underlying model that is used to 'reverse engineer' the underlying diversity of expectations. Hence while market prices have the advantage of being forward-looking, it must be kept in mind that interpreting the information contained in them is conditional on a theory about how asset prices are determined in the

market. In what follows we proceed on the assumption that the models we use accurately reflect the true determinants of asset prices.

III.1 *Characterizing market expectations using probability density functions.*

Market expectations about a currency's exchange rate in the future and market attitudes towards the risk of particular realisations can be compactly summarized in the entire risk neutral probability density function (PDF) which can be inferred from option prices. As noted, option values have the desirable property of being forward-looking in nature and thus are a useful source of information for gauging market sentiment about future values of financial assets. By studying a range of option prices with different strike prices, the distribution of all possible levels of future exchange rate can be estimated and used for assessing the credibility of exchange rate policies. The technique for extracting market expectations from option prices in this study is based on that in Malz (1997).[4]

Chart 3 shows the PDFs of the Hong Kong dollar exchange rate in a 1-month horizon as at 2 September 1996, 1 September 1997, 4 and 14 September 1998 and 13 September 1999, i.e. before and after the Asian financial crisis in 1997-8; and before and after the seven technical measures.[5] The statistics of the PDFs are reported in Table 1. The PDF as at 2 September 1996 shows that the exchange rate was not expected to be traded higher than 7.8. However, when the financial crisis emerged in the summer of 1997, the PDF as at 1 September 1997 dispersed with higher standard deviation and coefficient of variation. The uncertainty about the exchange rate anticipated by the market deepened and was extremely high in early September 1998 before the introduction of the policy measures. This is reflected from the fat-tailed PDF (high excess kurtosis) as at 4 September 1998 with large dispersion (high standard deviation and coefficient of variation). All statistics of the PDF reflects the potential depreciation of the Hong Kong dollar beyond 7.8 anticipated by market participants when the spot exchange rate was traded at 7.7458. After the announcement of the policy measures, the PDF as at 14 September 1998 became narrow with a high

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[4] A similar technique was applied in Mizrach (1996), Campa et al. (1997) and Söderlind (2000) to derive market expectations of "effective" bandwidths for ERM currencies.
[5] The HKMA introduced a time element into the CU on 14 September 1998.

probability around the mean. The change is more evident at their fat tails. In Chart 4, the fat tail of the PDF as at 4 September 1998 extends well beyond 8.5, while the fat tail as at 14 September 1998 disappears at 8.4. The substantial reductions in the corresponding statistics of the standard deviation and coefficient of variation also demonstrate the reaction of the market.[6] This demonstrates that the seven technical measures reduced the uncertainty about the exchange rate and thus confined the market expected exchange rate movement within a relatively narrow range. Furthermore, the change in expectations occurred immediately upon the announcement of the measures, suggestive of a high degree of credibility of the Monetary Authority. The narrow shape and corresponding statistics of the PDF as at 13 September 1999 suggest that the effects of the measures had been incorporated into the option prices to a large extent over the following one year, in particular the skewness and excess kurtosis reduced significantly compared with the PDF as at 14 September 1998.

Chart 3: PDFs of Hong Kong dollar exchange rate before and after seven technical measures.
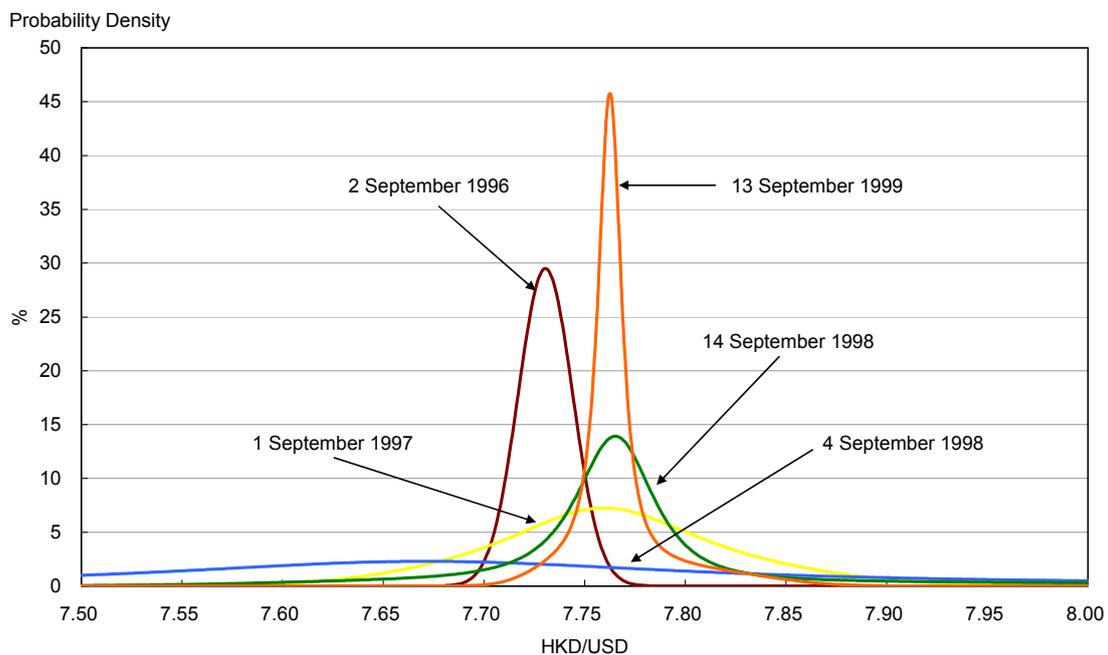

Table 1: Statistics of PDFs (before and after seven technical measures).

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[6] The smaller skewness and excess kurtosis of the PDF as at 4 September 1998 (compared with those as at 14 September 1998) are due to the extremely dispersed distribution.

Statistics	02/09/1996	01/09/1997	04/09/1998	14/09/1998	13/09/1999
Mean	7.7325	7.7642	7.7659	7.7852	7.7688
Standard Deviation	0.0135	0.0624	0.3034	0.1032	0.0226
Skewness	0.0054	0.0988	1.4071	2.2532	1.6520
Excess Kurtosis	0.0004	0.3776	3.1965	8.2383	5.2016
Coefficient of Variation	0.0017	0.0080	0.0391	0.0133	0.0029

Note: The coefficient of variation (CV) is a normalized measure of dispersion of a probability distribution.
It is defined as the ratio of the standard deviation to the mean.

Chart 4: Tails of PDFs of Hong Kong dollar exchange rate before and after seven technical measures.
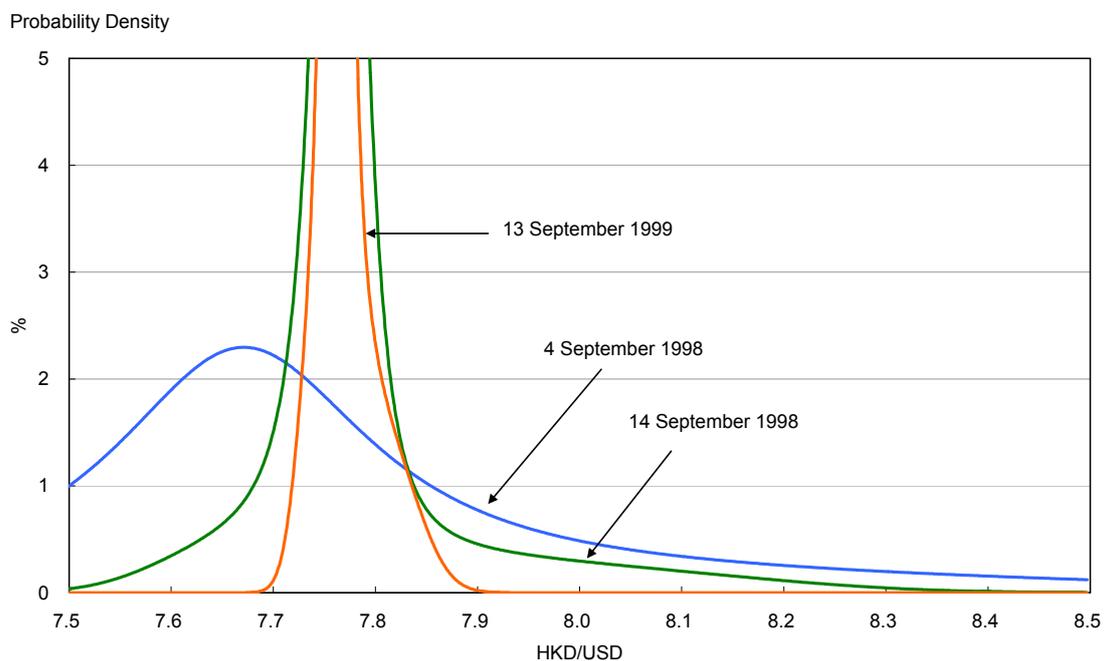
It should be noted that the Government's operations in the stock market in August 1998 could also be reason for the change in exchange rate expectations in September 1998.[7] As the culminating events of the stock market operations and the introduction of the seven measures occurred within two months, it is not possible to determine the contribution of each separately to the change in market sentiment. However, the fat-tailed PDF as at 4 September 1998 at least reflected that the effect of the stock market operations has not been rapidly incorporated into expectations by participants in the financial markets. In other words the narrowed PDF as at 13 September 1998 indicates that the introduction of the seven technical measures was useful even though not completely decisive.

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[7] This point was raised by Charles Goodhart.

The PDFs and the associated statistics of the exchange rate in a 1-month horizon before and after the three refinements on 18 May 2005 are shown in Charts 5 and 6 and Table 2.[8] The fat-tailed PDFs in Chart 5 with negative skewness and high excess kurtosis before the three refinements reflected the potential appreciation of the Hong Kong dollar anticipated by market participants. It is likely that these expectations were associated with the expectation of a revaluation of the renminbi and the belief by some market participants that the Hong Kong dollar might de-link from the US dollar and follow the renminbi. After the introduction of the three refinements, the PDFs in Chart 6 became narrow with a high probability around the mean, while the skewness became positive and the excess kurtosis reduced substantially. The PDF as at 20 May 2005 shifted slightly to the weak side compared with the PDF as at 18 May 2005, that may be due to the change of the weak-side CU from 7.8 to 7.85. As the exchange rate was now in a target zone regime, its PDFs became more or less symmetric, even after the revaluation of the renminbi on 21 July 2005. The mean of the PDFs was at the strong side of the Convertibility Zone as both the spot and forward exchange rates were stronger than the central parity. The PDFs demonstrate that the three refinements effectively reduced the uncertainty about the exchange rate and confined the market expected exchange rate movement well within the Convertibility Zone.

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[8]   The data as at 26 November 2004 are chosen because the option market somehow had less uncertainty about the exchange rate during early 2005. See section III.2 below for additional discussion.

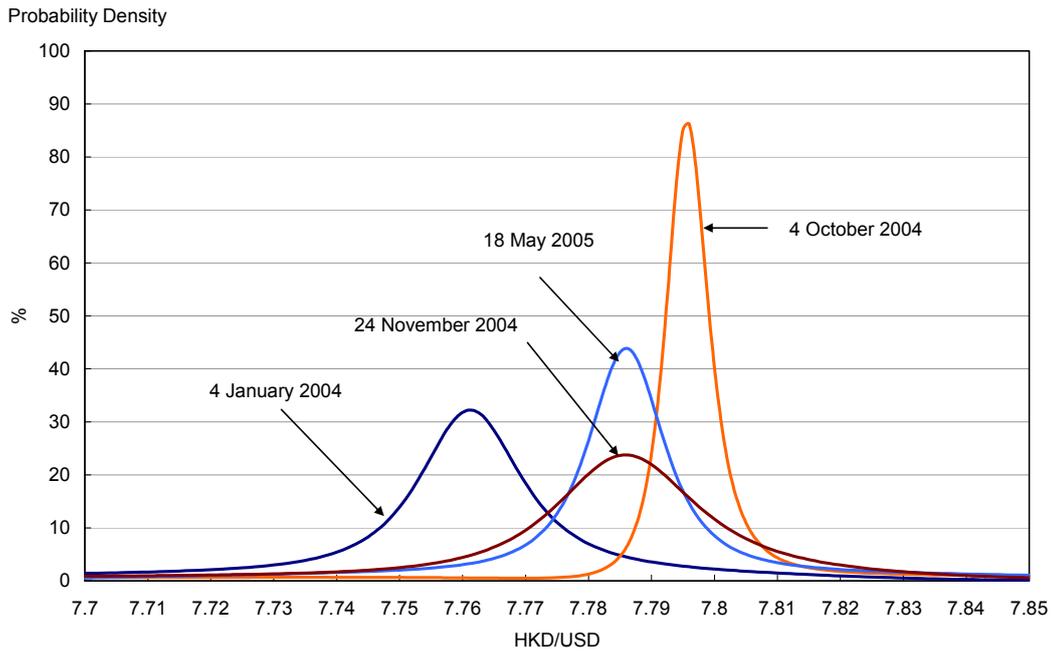**Chart 5: PDFs of Hong Kong dollar exchange rate before three refinements.**

Probability Density

Chart 6: PDFs of Hong Kong dollar exchange rate after three refinements.

Probability Density

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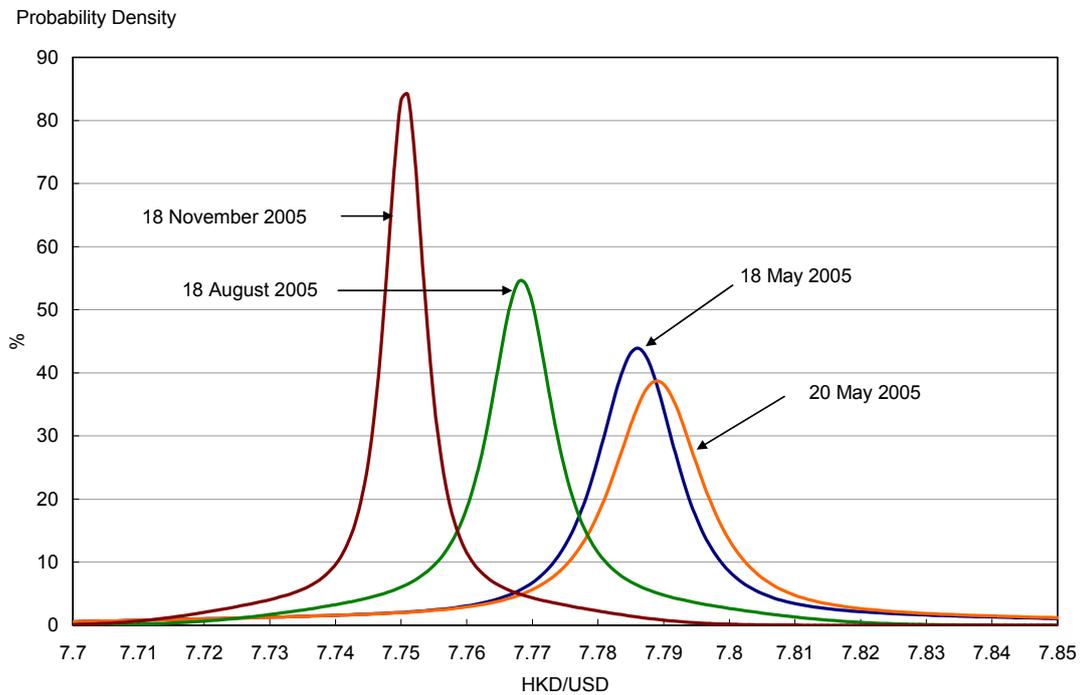
Table 2: Statistics of PDFs (before and after three refinements).

Statistics	04/01/2004	04/10/2004	24/11/2004	
Mean	7.7550	7.7903	7.7643	
Standard Deviation	0.0331	0.0310	0.0705	
Skewness	-1.6643	-2.6068	-2.6285	
Excess Kurtosis	5.2326	12.1466	7.6962	
Coefficient of Variation	0.0043	0.0040	0.0091	
	18/05/2005	20/05/2005	18/08/2005	18/11/2005
Mean	7.7870	7.7890	7.7684	7.7506
Standard Deviation	0.0270	0.0287	0.0146	0.0113
Skewness	0.0418	0.0407	0.0218	0.0266
Excess Kurtosis	4.8352	4.4506	2.6836	3.6633
Coefficient of Variation	0.0035	0.0037	0.0019	0.0015

Note: The coefficient of variation (CV) is a normalized measure of dispersion of a probability distribution. It is defined as the ratio of the standard deviation to the mean.

III.2 Market expectation of maximum appreciation/depreciation of Hong Kong dollar.

Another way of assessing the credibility of modifications to the LINK is to estimate the market expectation of the range of the movement of the exchange rate inferred from option prices. Hui et al. (2008a) propose an approach for estimating the maximum appreciation/depreciation of a currency expected in the financial market based upon a first-passage-time approach.[9] This approach considers that path dependency is a critical factor that allows substantial appreciation/depreciation of an exchange rate triggered by an important economic-political event during a time horizon. There is a significant difference between expected maximums measured by the path-independent approach which is used for constructing probability density functions in the previous subsection, and by the path-dependent approach. The measurement of the path-independent approach depends on the exchange rate only at the end of some time interval, and not on a particular path. This means that the path-independent maximum/minimum does not take into account the exchange rate reaching at a high/low level during some time interval. The expected maximum appreciation/depreciation of the Hong Kong dollar estimated by the first-passage-

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[9] The use of the first-passage-time approach is first proposed by Hui and Lo (2008) for estimating the realignment risk of a currency within a target zone. This approach is different from the path-independent approach (such as in Mizrach (1996) and Söderlind (2000)) which provides the expectations of the exchange rate movements only at the end of a given time horizon and ignores any substantial movement triggered by an important economic-political event during a time horizon.

time approach could therefore be used to assess the expected trading bands anticipated by the market and hence the credibility of the Linked Exchange Rate system.

The model parameters used to estimate expected maximum appreciation/depreciation of the Hong Kong dollar are spot exchange rates (the Hong Kong dollar value of a unit of the US dollar, HKD/USD), Hong Kong dollar 1-month HIBOR, US dollar 1-month LIBOR, and volatility implied from 1-month at-the-money-forward currency option prices covering the period from 2 January 1996 to 8 October 2008. The forward exchange rate is computed from the interest rate parity between the Hong Kong dollar and US dollar. Chart 7 presents day-by-day estimates of 1-month expected maximum appreciation/depreciation of the Hong Kong dollar. A general observation prompted by this chart is that the estimated maximum expected trading range of the Hong Kong dollar exchange rate has been quite narrow with the notable exceptions of the 1997-98 and 2003-2005 episodes. This is presumably a reflection of both the credibility of the peg and the absence of major shocks striking the system except in these two episodes.

Chart 7: 1-month expected maximum appreciation/depreciation of the Hong Kong dollar.
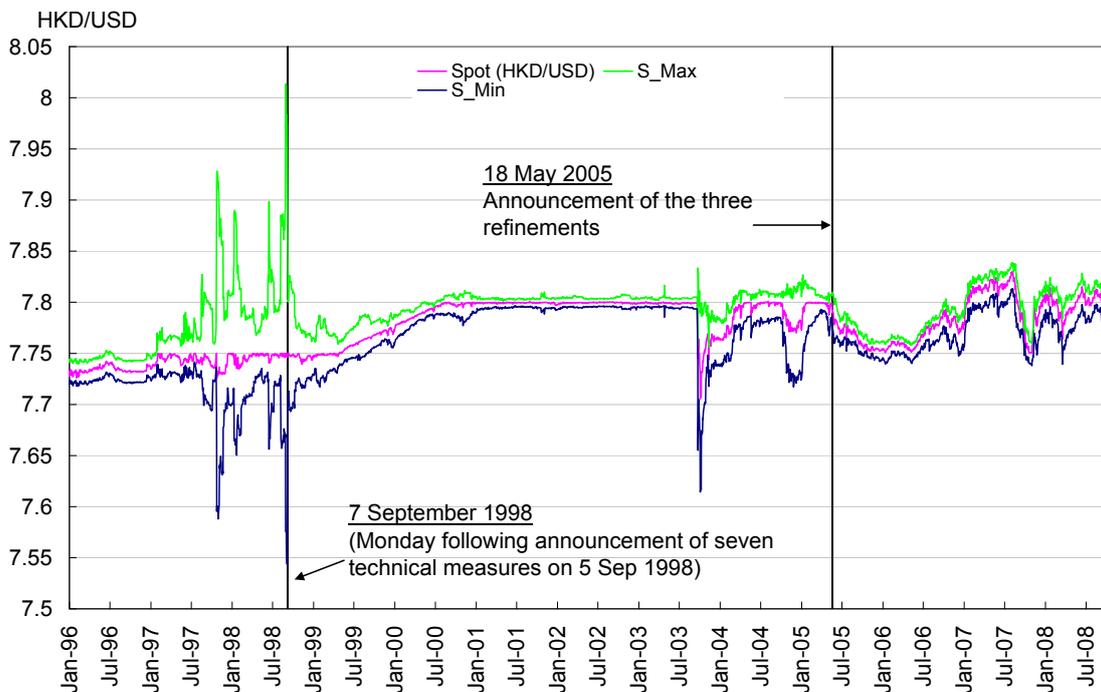
Looking more closely at the period of the Asian financial crisis from October 1997 to September 1998, the expected maximum deprecations of the Hong Kong dollar were much beyond 7.8 on a number of days, while the spot exchange rate was traded around 7.75. In particular, the market expected maximum depreciation in 1-month horizon was at 8.01 on 31 August 1998 (see Chart 8). Following the announcement of the seven technical measures, the expected trading bands narrowed substantially and the expected maximum depreciation fell immediately to 7.8. While it increased to 7.83 a week after the announcement, it continued to decline thereafter and a month later it was again below 7.8 and would effectively stay there until the spot rate had been moved to that level as well after which the expected maximum trading range was very narrow around the weak-side commitment of 7.8 HKD/USD. The technical measures thus reduced the uncertainty of market participant in a short period of time.

The expected trading bands in the one-month horizon began to widen again when appreciation pressure on the Hong Kong dollar emerged in October 2003 due to revaluation pressures on the renminbi. Uncertainty about the Hong Kong dollar exchange rate remained until the implementation of the three refinements on 18 May 2005. As there was only the weak-side CU at 7.8 during the period, the Hong Kong spot exchange rate was traded below 7.8 and the expected maximum appreciations were frequently substantially below 7.75.

Chart 8: 1-month expected maximum appreciation/depreciation of the Hong Kong dollar.
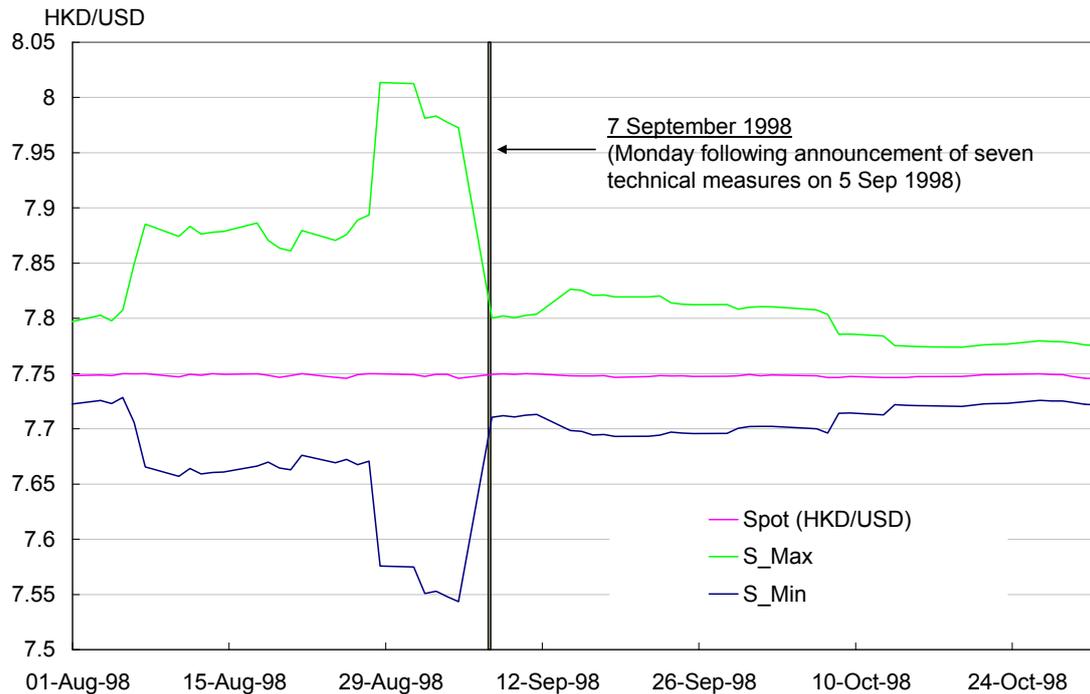
Looking more closely at the months preceding the 18th of May, we note (see Chart 9) that the narrowing of the expected trading range had already started in the beginning of 2005 as if market participants anticipated the three refinements. A possible reason for this could be the efforts of the HKMA to persuade market participants that there was no to assume that pressure on the renminbi would lessen the resolve of Hong Kong's authorities to allow the Hong Kong dollar to appreciate far from the 7.8 level. In a Viewpoint article published on November 24, 2004, the Chief Executive of the HKMA, Mr. Joseph Yam, discussed the reasons for the negative differential between Hong Kong dollar interest rates and the corresponding US dollar counterparts.[10] He gave reasons why he believed that they would only be temporary and wrote about investors that: "Some may, of course, have longer staying power than others, but I think none has longer staying power than the Linked Exchange Rate system itself". He also wrote that using the Hong Kong dollar as a proxy for speculating on an appreciation of the renminbi "is, to put it mildly, a little far fetched". He continued

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[10] Viewpoint articles by Mr. Yam are published on the HKMA website. They are frequently used to explain the assessment by the Monetary Authority of significant monetary and financial developments, and can thus be thought of as attempts to influence the public's understanding of HKMA policies.

to suggest that it may take time for investors to realize this but that when they do "Hong Kong dollar interest rates will rise".[11]

Again in another Viewpoint article dated December 31 he again discussed the issue of using the Hong Kong dollar as a proxy for speculation on an appreciation of the renminbi and, suggesting it may be risky, he wrote that "[t]hose using the Hong Kong dollar as a proxy for taking positions on the renminbi should take note".

These statements can, we believe, be interpreted as signalling to the markets that they should not assume that the low interest rates in Hong Kong would last forever. As low interest rates can be related to expectations of appreciation of the Hong Kong dollar, the Viewpoint articles could have had the effect of diminishing these expectations ahead of the changes brought about by the three refinements in May 2005. The actual implementation of the three refinements consolidated the relatively small differences between the spot rate of the Hong Kong dollar and its expected strongest value which usually has been well above the strong-side CU at 7.75. This reflects that the policy once again reduced the uncertainty of market participants.

Chart 9: 1-month expected maximum appreciation/depreciation of the Hong Kong dollar.

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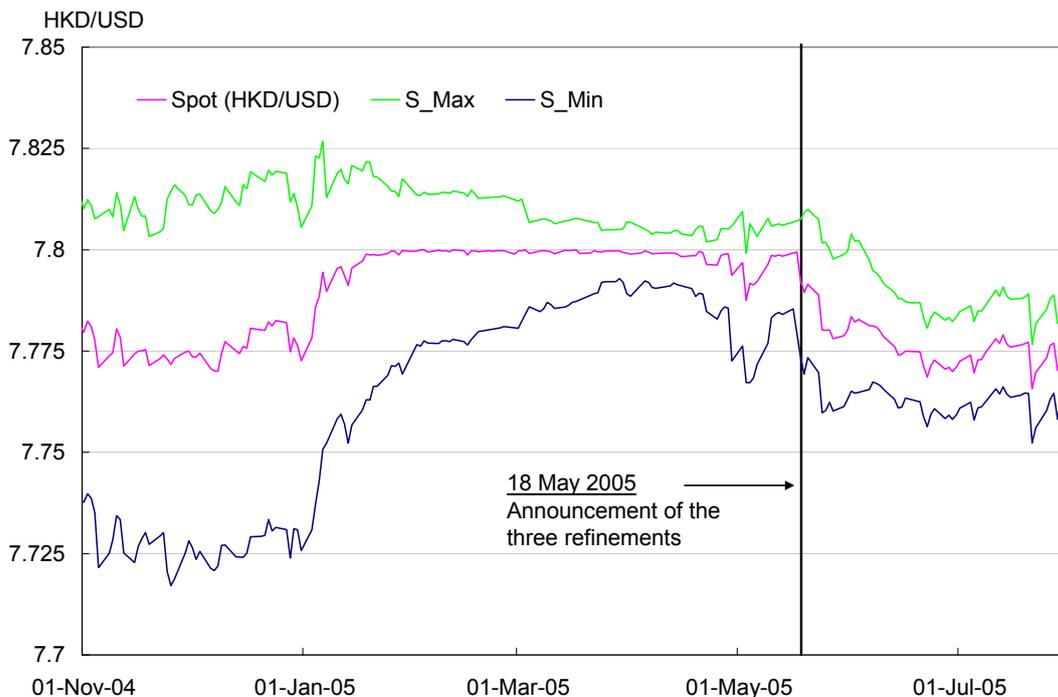
[11] Rising Hong Kong dollar interest rates would imply a narrowing interest differential and, through interest parity, a smaller expected appreciation of the Hong Kong dollar.

IV.   Volatility of Hong Kong dollar exchange rate and interest rate and their interaction.

It is sometimes asserted that pegging the exchange rate entails a trade-off between interest-rate volatility and exchange-rate volatility. The argument is that in order to stabilize the exchange rate in the face of excess demand or supply in the foreign exchange market, the authorities must adjust interest rates in order to induce offsetting capital flows. Conversely, a central bank that conducts monetary policy using the rate of interest must allow the exchange rate to adjust in response to shocks.

While there is certainly some truth to this line of reasoning, it is incomplete since it does not take into account the possibility of stabilizing speculation in the foreign exchange market by the private sector in a perfectly credible fixed exchange rate system. For when the private sector has complete confidence in the peg, there will be less need for interest rate adjustments to preserve the fixed exchange rate. Private sector fund flows will ensure stability much as they do in a monetary union.

In this section we investigate the evolution of volatilities in the exchange rate and interest rates using models popular in the finance literature to capture changes in volatilities over time as well as their interactions. As the movements of the Hong Kong dollar interest rate should follow the US dollar counterparty under the Linked Exchange Rate system, the interest rate differential between them is used to gauge the interest rate volatility. This means that the volatility of the Hong Kong dollar interest rate relative to the US dollar interest rate is the measure for assessment.[12]

The Hong Kong dollar and US dollar (HKD-USD) interest rate differential and the change (in natural log difference) in the Hong Kong dollar exchange rate are modelled under a univariate AR(1) – Exponential GARCH(1,1) specification respectively as follows:[13]

$$y_t = w_0 + w_1 y_{t-1} + \varepsilon_t \qquad\qquad (1)$$

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[12] Fung and Yu (2007) employ Bayesian analysis, which takes into account the exchange rate movements and interest rate differential to assess the credibility of the Convertibility Zone.
[13] We are grateful to Pierre Siklos for suggesting that the exponential garch specification could be more appropriate than a symmetric garch model in view of the asymmetric nature of the exchange rate commitment during the period after the technical measures and before the three refinements.

$$\ln(\sigma_t^2) = c_0 + \alpha_1 \ln(\sigma_{t-1}^2) + \beta_1 \left| \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \right| + \gamma_1 \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \qquad (2)$$

where y_t is the HKD-USD interest rate differential or the change in the Hong Kong exchange rate (HKD/USD), and σ is the corresponding volatility. The presence of asymmetry is measured by the estimated coefficient γ_1. The tenors of the interest rate differentials are overnight and 3 months. The estimation results of the volatility σ, one year before the Asian Financial crisis (from 2 January 1996 to 30 June 1997), before and after the seven technical measures on 7 September 1998 and the three refinements on 18 May 2005 are in Table 3.[14]

Table 3: Volatility Comparison.

		Volatility (in standard deviation)		
			HKD – USD Interest rate differential	
		HKD/USD exchange rate	Overnight	3-month
January 1996 to June 1997		0.00025	0.00394	0.00064
Technical measure on 7 September 1998	1-year before	0.00034	0.01122	0.02256
	1-year after	0.00022	0.00585	0.00204
Three refinement on 18 May 2005	1-year before	0.00028	0.00201	0.00095
	1-year after	0.00029	0.00304	0.00071

The results in Table 3 show that both the exchange rate volatility and interest rate volatility increased substantially during the Asian financial crisis from September 1997 to September 1998, compared with those during the pre-crisis period. After the announcement of the seven technical measures, they declined to levels comparable to the pre-crisis period. This is consistent with the findings based on the option implied volatility of the Hong Kong dollar exchange rate in the previous section. However, the reduction in volatility is not so noticeable when we compare the periods immediately before and after the three refinements. In

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[14] The currency crisis in Thailand occurred in July 1997. The estimation results of Eqs. (1) and (2) are available upon request.

particular the volatility of the overnight interest rate differential has increased afterwards. This may be due to a number of large scales initial public offering of stocks during the period between 2005 and 2007 that increased the demand of the Hong Kong dollar and overnight funding. Nevertheless, it is interesting to note that when we compare exchange rate and interest rate volatilities in the current target zone (i.e. after the three refinements) with those that prevailed in the pre-crisis period, there is no evidence that the more rule-based exchange rate system currently in place is associated with any increase in interest rate volatility.

To study the relationship between the exchange rate and interest rate volatility, a bi-variate GARCH model is modified and employed to estimate the mean and volatility spill-overs between them. A conditional mean spill-over under a AR(1) specification is defined as:

$$IRD_t = w_{10} + w_{11} IRD_{t-1} + w_{12} EXR_{t-1} + \varepsilon_{1,t}$$

$$EXR_t = w_{20} + w_{22} EXR_{t-1} + w_{21} IRD_{t-1} + \varepsilon_{2,t}$$

$$\begin{bmatrix} \varepsilon_{1,t} & \varepsilon_{2,t} \end{bmatrix}' \sim N\left(0, \begin{pmatrix} h_{11,t} & h_{12,t} \\ h_{21,t} & h_{22,t} \end{pmatrix}\right) \tag{3}$$

where *IRD* refers to the HKD-USD interest rate differential (overnight or 3-month) and *EXR* refers to the HKD/USD exchange rate return. The mean spill-over is measured by the estimated coefficients w_{12} (from the lagged exchange rate return to the interest rate differential) and w_{21} (from the lagged interest rate differential to the exchange rate return).

The conditional variance-covariance matrix is used to capture the volatility spill-over. The matrix is constructed as:

$$h_{11,t} = c_{11} + \alpha_{11} \varepsilon_{1,t-1}^2 + \beta_{11} h_{11,t-1} + \gamma_{11} h_{22,t-1}$$

$$h_{22,t} = c_{22} + \alpha_{22} \varepsilon_{2,t-1}^2 + \beta_{22} h_{22,t-1} + \gamma_{22} h_{11,t-1} \tag{4}$$

$$h_{12,t} = c_{12} + \alpha_{12} \varepsilon_{1,t-1} \varepsilon_{2,t-1} + \beta_{12} h_{12,t-1} + \gamma_{12} h_{12,t-1}$$

The volatility spill-over is measured by the estimated coefficients γ_{11} (from the lagged conditional variance of the exchange rate return to the conditional variance of the interest rate differential) and γ_{22} (from the lagged conditional variance of the interest rate differential to the conditional variance of the exchange rate return). Table 4 presents the estimation results under the bi-variate GARCH specification with mean and volatility spill-overs during the periods before and after the implementation of the policy measures.

The results show that the volatility spill-over from the exchange rate return

to the interest rate differential (i.e. γ_{11}) was statistically significant and positive before the seven technical measures. However, the volatility spill-over from the interest rate differential to the exchange rate return (i.e. γ_{22}) is statistically significant and negative. This is consistent with the notion that an increase in exchange rate volatility triggered an increase in interest rate volatility before the seven technical measures. Conversely, the increase in the interest rate volatility dampened the exchange rate volatility.   During the period between the implementations of the seven technical measures and 23 September 2003 (when revaluation pressure on the renminbi emerged), γ_{11} is statistically insignificant while γ_{22} is statistically significant and positive with a smaller magnitude compared with the figures before the seven measures. This indicates that the spill-over effect was weakened after the implementations of the seven technical measures, and it can be interpreted as the result of an increasing the credibility of the LINK leading to stabilizing flows in the foreign exchange market obviating the need for interest rate adjustments to maintain the peg.

Between September 2003 and the introduction of the three refinements, the positive γ_{11} for the volatility of the exchange rate return and the overnight interest rate differential indicates spill-over between them. The spill-over disappears after the introduction of the refinements. It may be tempting to interpret this as a further increase in the credibility of the system. However, this is not the message one gets from the results using 3-month interest rates, because after the introduction of the three refinements, the positive γ_{11} and negative γ_{22} for the volatility of the exchange rate return and the 3-month interest rate differential show that the spill-over between them is present within the Convertibility Zone. Nevertheless, in both cases the size of the spill-over is small compared to what was observed before the introduction of the seven technical measures in 1998.

Table 4: Parameter Estimates of the Bivariate GARCH Model by Sub-sample Periods.

	Before the "Technical Measures" on 7 Sep 1998		After 7 Sep 1998 and before revaluation pressure on the renminbi emerged on 23 Sep 2003		From 23 Sep 2003 to 18 May 2005		From 23 Sep 2003 onwards	
	Overnight HKD-US interest rate differential — HKD/USD exchange rate return	3-month HKD-US interest rate differential — HKD/USD exchange rate return	Overnight HKD-US interest rate differential — HKD/USD exchange rate return	3-month HKD-US interest rate differential — HKD/USD exchange rate return	Overnight HKD-US interest rate differential — HKD/USD exchange rate return	3-month HKD-US interest rate differential — HKD/USD exchange rate return	Overnight HKD-US interest rate differential — HKD/USD exchange rate return	3-month HKD-US interest rate differential — HKD/USD exchange rate return
w_{12}	-0.2638 (0.4844)	0.0727 (0.0512)	-0.6934 (0.5594)	0.0510 (0.1706)	**-0.3290* (0.0633)**	**0.0509* (0.0182)**	**-0.2652* (0.0978)**	**0.1394* (0.0230)**
w_{21}	**-0.0043* (0.0005)**	0.0008 (0.0008)	**-0.0006* (0.0003)**	-0.0003 (0.0003)	-0.0053 (0.0028)	**-0.0309* (0.0013)**	**-0.0037* (0.0012)**	**-0.0057* (0.0016)**
α_{11}	0.4121* (0.0334)	0.7249* (0.0081)	0.9001* (0.0036)	0.9155* (0.0051)	0.8028* (0.0083)	0.8860* (0.0055)	0.8446* (0.0055)	0.8128* (0.0088)
β_{11}	0.6433* (0.0206)	0.8415* (0.0149)	0.4904* (0.0130)	0.4365* (0.0140)	0.9332* (0.0435)	0.5664* (0.0166)	0.5933* (0.0162)	0.5897* (0.0189)
γ_{11}	**13.8184* (0.4296)**	**1.1066* (0.0701)**	-0.1405 (10.4393)	-0.3475 (0.4390)	**0.3551* (0.1017)**	-0.0117 (0.0340)	-0.0008 (34.4586)	**0.3227* (0.0450)**
α_{22}	0.7321* (0.0141)	0.8584* (0.0040)	0.9639* (0.0046)	0.9589* (0.0056)	0.9595* (0.0042)	0.6399* (0.0124)	0.9551* (0.0023)	0.9443* (0.0027)
β_{22}	0.6093* (0.0177)	0.5100* (0.0083)	0.2096* (0.0130)	0.2153* (0.0141)	0.2266* (0.0177)	1.2801* (0.0207)	0.2770* (0.0083)	0.3009* (0.0085)
γ_{22}	**-0.0189* (0.0013)**	**-0.0535* (0.0024)**	**0.0011* (0.0003)**	**0.0046* (0.0012)**	0.0039 (0.0026)	-0.0003 (0.4988)	0.0004 (0.0317)	**-0.0327* (0.0051)**
No. of observations	1,215	2,519	1,310		432		1,306	

Notes: The series of the overnight and the 3-month HKD-US interest rate differential start from 10 January 1994 and 10 January 1989 respectively. The series end at 23 September 2008. Numbers in parentheses are standard errors. * denotes coefficient significant at the 5% level.

V.   Hong Kong dollar exchange rate dynamics in the target zone.

V.I   Has the exchange rate process been mean-reverting since the three refinements?

The introduction of the three refinements to the currency board on 18 May 2005 established that the HKMA committed itself to maintain the HKD/USD exchange rate within a zone from 7.75 to 7.85 HKD per USD. It will do so by standing ready to intervene by unlimited amounts at the limits of this zone to prevent the exchange rate from braking through the limits. This type of exchange rate system has been referred to as a target zone model in the economics literature.

It has been argued that one can infer whether an exchange rate target zone is credible by studying the statistical properties of the movements in the exchange rate inside the zone. One school of thought argues that if the target zone is credible the exchange rate process must be mean-reverting, i.e. that there must be a tendency for the exchange rate to converge to the middle of the zone.

The driving force behind the mean-reverting property has been widely debated.[15] Some attribute it to central bank intervention within the target zone.[16] Others argue that credibility induces "stability speculation" by market participants, producing forces to pull the exchange rate back to the central parity whenever it drifts away too much from it.[17]

Another school of thought argues that the fact that the exchange rate behaves as a random-walk is not necessarily inconsistent with a credible target zone, provided that it is a bounded process.[18] There are many reasons for the exchange rate to have such a property, the most obvious one being potential central bank intervention and the ability of the central bank to defend the band. As long as 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

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[15] For example, Krugman (1991), Svensson (1993), Rose and Svensson (1994), and Anthony and MacDonald (1998).

[16] But the exchange rate may not exhibit such a property if intervention occurs only at the limits of the target zone.

[17] Many empirical studies attempted to investigate this theoretical prediction by examining the time-series properties of the European currencies in the era of the Exchange Rate Mechanism. Unfortunately, the results of these studies were mixed, for example, Ball and Roma (1994), Svensson (1993), Rose and Svensson (1994), Nieuwland et al. (1994), Anthony and MacDonald (1998, 1999), and Kanas (1998). Some of the currencies were found to follow a random-walk process.

[18] See Nicolau (2002).

encouraged to pull the exchange rate towards the central parity. However, when the exchange rate moves closer to the boundary, the market may anticipate an intervention and push the rate back suddenly. Simply put, a bounded process contains a reversion effect that only occurs close to the boundaries of the zone but not in or around the middle. Statistically, it is thus possible for the random walk and bounded properties to co-exist, and together they are consistent with a credible system. The history of exchange rate movements since May 2005 gives us an opportunity to study the properties of the Hong Kong dollar under the new arrangement and, in particular, whether the currency follows a mean-reverting process.[19]

Hui and Fong (2007) study the dynamics of the daily Hong Kong dollar spot rate from 18 May 2005 to 29 August 2007 based on the augmented Dickey-Fuller (ADF) test and the variance-ratio (VR) test to determine whether the time series exhibit stationary and mean-reverting properties. They find that that after the introduction of the three refinements to the Linked Exchange Rate system in May 2005 the Hong Kong dollar does not show any strong tendency to revert towards the centre of the Convertibility Zone. The results of the empirical tests based on a discrete-time econometric model using the maximum likelihood technique suggest, however, that the Hong Kong dollar followed a bounded process, one that is consistent with a fully credible exchange rate band.

Casual observations of recent movements of the exchange rate suggest that the process might be different now than during the sample period studied by Hui and Fong. Looking at Chart 1 in Section II it seems that the exchange rate has often been hovering around the middle of the convertibility zone since sometime in the second half of 2007, suggestive of a mean-reverting tendency. One hypothesis is that the intra-marginal intervention in the foreign exchange market carried out by the HKMA on 23 October of that year has changed the dynamics of the exchange rate.[20] On that day, the Hong Kong dollar spot exchange rate once touched 7.75 although no banks approached the HKMA to activate the strong-side CU. The HKMA nevertheless intervened inside the target zone by selling Hong Kong dollars for US dollars. Subsequently the strong side CU was triggered once

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[19] Hui et al. (2008b) find that the 3-month and 12-month Hong Kong dollar forward exchange rates against the US dollar were mean-reverting during the period from 2 January 1996 to 4 March 2005.

[20] Theoretical models of target zone exchange rate regimes predict that this would be the case.

on 26 October and five times on 31 October prompting further interventions.[21]

Following the methodology used in Hui and Fong we test for the existence of a break point in the time series process of the Hong Kong dollar in the second half of 2007.[22] We find that the process changes substantially after the break point identified to take place on 23 August 2007. In particular, from that date until the end of our sample (30 September 2008) the time series appears to be stationary in levels based the ADF test. In other words, during this period there exists a driving force in the Hong Kong dollar exchange rate dynamics to pull the rate towards the central parity. Although the exact break point identified by our tests does not coincide with the intra-marginal intervention in October 2007, it is close enough that one may still suspect that the actions at the time of the HKMA have had some impact on the subsequent behaviour of market participants and hence on the exchange rate itself.

To further test the exchange rate dynamics after the break point, we adopt the following specification of the bounded process:

$$dx_t = \kappa\left(\ln\theta - \ln x_t\right)x_t\,dt + \sigma_t\left(-\ln x_t\right)^\gamma x_t\,dz_t \qquad (5)$$

where the Hong Kong dollar exchange rate S is transformed into x with a scale from zero to one:

$$x_t = \frac{S_t - 7.75}{7.85 - 7.75},$$

(6)

$\sigma^2\left(-\ln x\right)^{2\gamma}x^2$ is the variance that depends on the level of S, γ is a real number, dz is a standard random process and κ determines the speed of adjustment towards a mean of θ that represents the mean-reverting process.[23] It is noted that x is between zero and one as S is between 7.75 and 7.85. If the coefficient γ is positive, the process will be bounded, because when S gets very close to either of the CUs (7.75 and 7.85), the variance of the exchange rate vanishes.[24] This in turn implies that the exchange rate is unlikely to touch either CU. The larger is γ,

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[21] See the December 2007 Half-Yearly Monetary Stability Report of the HKMA, page 52. It can be found at http://www.info.gov.hk/hkma/eng/public/qb200712/E_Halfyear.pdf

[22] The method in Zivot and Andrew (1992) based on trend and mean is used to test the break point.

[23] The specification of the bounded process is generalized from the specification used in Lo (2007).

[24] This is a consequence of the choice of functional form for x and its stochastic process. When S converges to 7.75, (-lnx)x will converge to zero. On the other hand, when S is 7.85, x is 1 and lnx is zero, hence (-lnx)x is zero.

the more sensitivity is the variance of the exchange rate process to the distance from the target zone limit.

The maximum likelihood estimation results are presented in Table 5. The Ljung-Box test statistics suggest that the model is adequately fitted because the standardised residuals are not serial correlated and not heteroskedastic.[25, 26] The parameters for the drift, κ and θ, are estimated to be 0.085 and -0.718 respectively, while the parameter for the variance, σ and γ, are 0.126 and 1.811 respectively. The coefficients are all statistically significant. Chart 10 shows the annualized volatility in the exchange rate (i.e. change in the exchange rate value) at different levels under the bounded process, that approaches zero at the strong- and weak-side limits.[27]

Table 5: Maximum likelihood estimations of discrete-time econometric model.

| Parameter Variable	Estimated Coefficients	Standard Error	P-value
κ	0.0849**	0.0282	0.0026
θ	-0.7180**	0.0616	0.0000
σ	0.1259**	0.0053	0.0000
γ	1.8113**	0.1110	0.0000
Log likelihood	267.3085		
Ljung-Box test on standardized residuals up to lag 24	36.677		0.050
Ljung-Box test on squared standardized residuals up to lag 24	26.495		0.329
Observations		238	

Notes: ** and * denotes coefficient significant at the 1% and 5% levels respectively.

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[25] The Ljung-Box test, similar to the Portmanteau test, identifies whether the autocorrelations among data are jointly zero up to a specified lag. Compared with the Portmanteau test, it is more powerful. Accepting the null hypothesis of the test means that the data is not serial correlated.

[26] The standardized residual is the residual divided by the estimated volatility. If the model fits well, the standardized residuals will be serial uncorrelated and homoskedastic. The homoskedasticity can be checked by the Ljung-Box test on the jointly zero-autocorrelation among the squared standardised residuals. Accepting the null hypothesis of the test suggests that the standardised residuals are homoskedastic. See McLeod and Li (1983) for details.

[27] The changes are not symmetric at the central parity because most of the time the exchange rates had stayed in the strong-side Convertibility Zone during the estimation period.

Chart 10: Annualised volatility in HKD exchange rate at different levels.
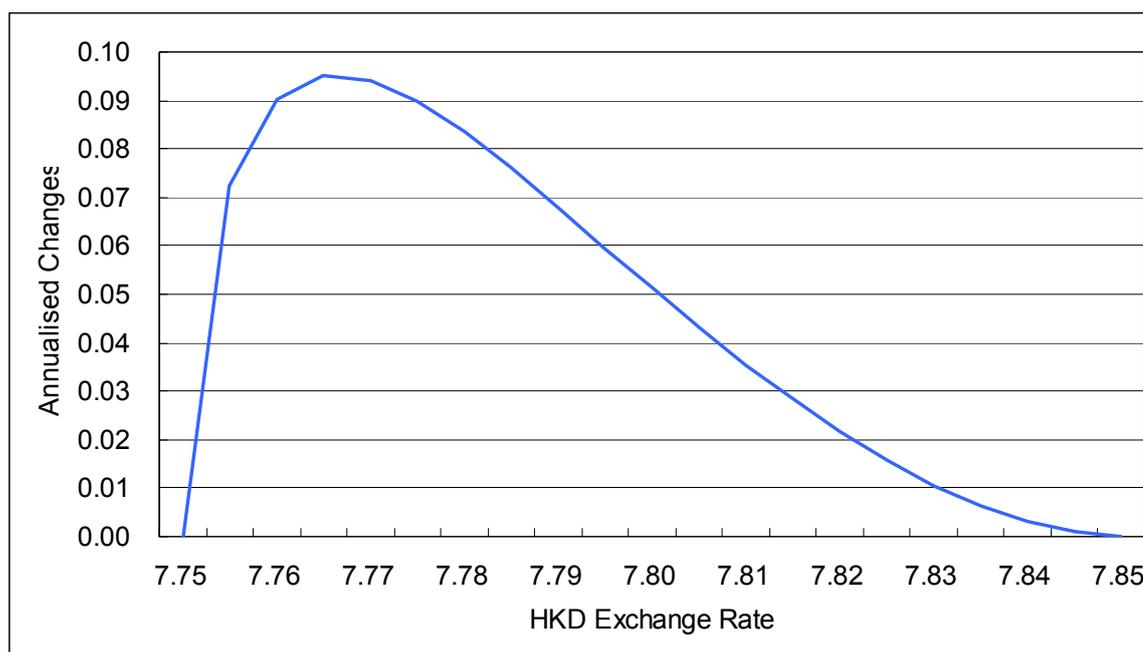
The empirical tests show that the mean-reverting process and bounded process co-exist in the Hong Kong dollar dynamics after the break point. The presence of mean reversion reflects that market participants have anticipated the Hong Kong dollar exchange more sticky towards the central parity.

### V.II A remaining puzzle: evidence on credibility from the forward exchange market.

The evidence presented so far suggests that the current target zone system enjoys a substantial amount of credibility by market participants as there has been only one episode during which the (strong-side) CU has been hit, and since the Hong Kong dollar spot rate appears to be mean-reverting inside the convertibility zone. Furthermore, the credibility seems to have been achieved from the very start of the new regime as judged by the evidence in sections III and IV. On this interpretation of the evidence, the behaviour of the 12-month forward exchange rate presents a puzzle.

Chart 11 shows that the 12-month forward rate of the HKD against the USD was consistently been outside the convertibility zone between October 2005 and the end of 2007 and on several occasions since then. This implies that profits

could be made on outright forward contracts during such periods provided that the future spot rate stays within the convertibility zone. If we interpret the forward rate as an indicator of expected value of the future spot rate on the part of market participants, this seems to suggest that there are doubts in the market about the commitment of the HKMA to 7.75 as the strong side CU.[28]

Of course, there are reasons why positions in outright forward contracts may not be taken even if the expected future spot rate is different from the forward rate. One such reason is transactions costs which refer not only to bid-ask spreads, but also to allocating scarce human or other resources to this particular market and away from other markets.[29] Another reason could be risks of mark-to-market losses in the event that the forward rate moves even further away from the convertibility zone. Traders may have limits on the size of such losses they may incur, which could limit their ability to engage in this type of trade.

Chart 11: HKD 12-month forward exchange rate.

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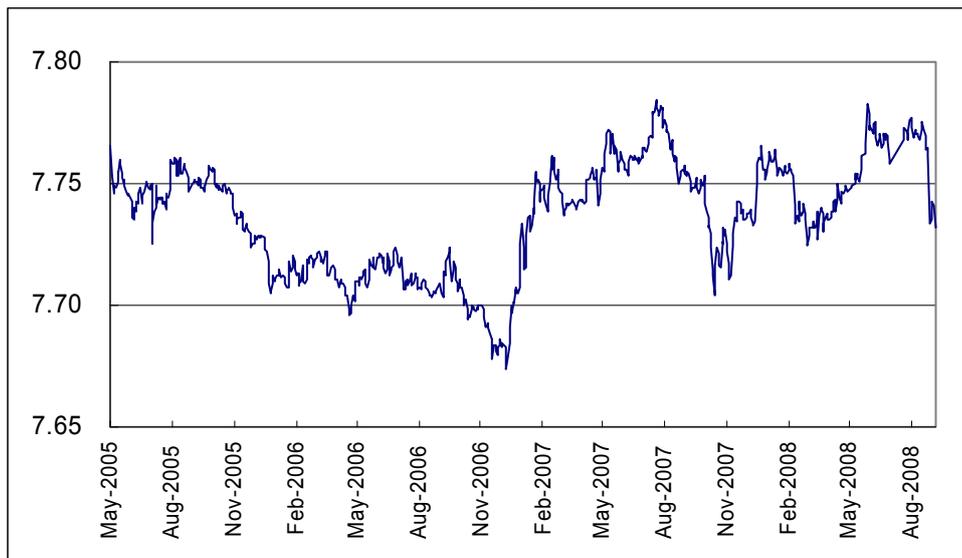
[28] The 'expected value of the future spot rate' should be interpreted in the statistical sense as the probability-weighted sum of possible future values of the spot rate. The probabilities in question are the subjective probabilities held by market participants. Viewed in this way, the forward rate need not be the most likely (i.e. with the highest probability) value of the future spot rate. It could for example be that the current value of the forward rate reflects a high probability that the future spot rate will stay within the convertibility zone together with a relatively small probability attached to a large appreciation of the HKD, i.e. a small probability that the bands of the convertibility zone will be changed.

[29] Although one would have thought that this type of trade could be carried out relatively mechanically through program trading which would substantially reduce the opportunity cost aspects.

So it may be that market expectations of future spot rates are consistent with the convertibility zone without trading taking place to force the forward rate always to lie inside the zone. While this would be in line with our general argument that the current systems enjoys a large degree of credibility, the behaviour of the forward rate in the period following the introduction of the new exchange rate for the renminbi casts some doubt on this interpretation. Chart 12 shows the movement of both the HKD/USD 12-month forward exchange rate and the 12-month non-deliverable forward (NDF) rate for the renminbi relative to the US dollar from during the period from the introduction of the three refinements and until the end of February 2007. It is quite clear that the broad movement of the HKD forward rate mimicked closely those of the NDF rate during part of this period, specifically from July 21 (the start of the new exchange rate regime for the renminbi) until the end of 2007. Whatever factors determined the movements of the NDF rate also seem to have been responsible for movements in the HKD forward rate. If indeed these rates reflected expectations about future spot rates, then it seems that market participants placed some non-negligible probability on the possibility that the HKD would follow the RBM as it appreciated during this period. [30,31]

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[30] Note that commentators regularly use the value of the RMB NDF as an indicator of what the market expects the future RMB spot rate to be. Symmetry suggests that a similar interpretation of the HKD forward rate may be warranted. It is worth noting that while the forward rate is frequently used as an indicator of the market's expectation of the future spot rate, empirical studies on most currencies show that it does not turn out to be a very accurate predictor, ex. post..

[31] A regression of the Hong Kong dollar forward rate on the renminbi NDF for this period gives an R^2 in excess of 75%.

Chart 12: 12-month forward exchange rates.
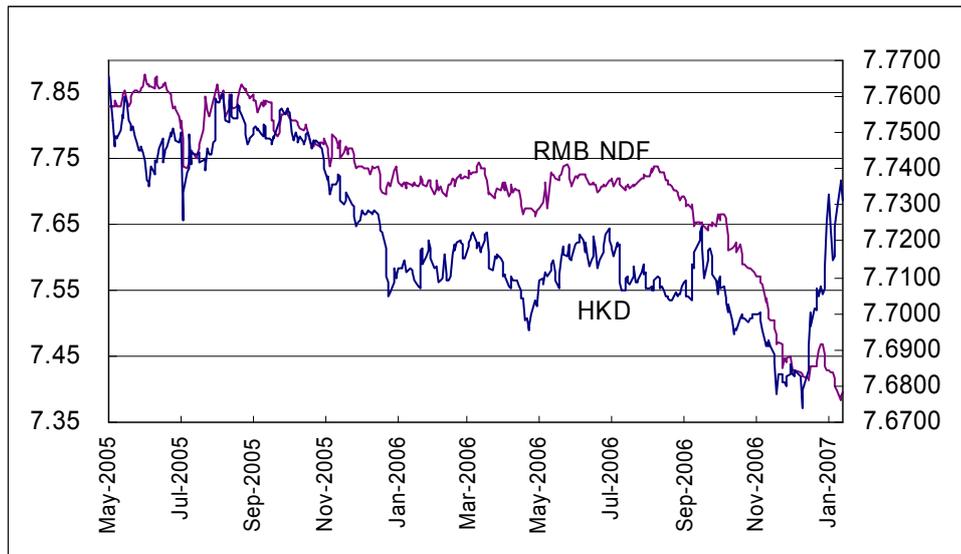
What would explain such expectations, and why did they seem to have changed at the end of 2007? Two factors may explain the reasons behind the expectations of a link between the Hong Kong dollar and the renminbi. The first is the increasing trade and financial linkages between Hong Kong and Mainland gave rise to arguments in some quarters that it would be in Hong Kong's interest to link its currency to the renminbi rather than to the US dollar. Although it was possible to refute this argument on strictly economic grounds,[32] a second factor made the idea seem superficially attractive. This was that the steady appreciation of the renminbi made it almost certain that it would reach 7.8 RMB/USD sometime in late 2006 or early 2007, in other words that there would be parity between the Hong Kong dollar and the renminbi. Some observers thought that would be an opportune time to peg Hong Kong's currency to that of the Mainland.

Why did the co-movements between the two forward rates cease come around the end of the year. A possible explanation relies on the communication efforts of the HKMA. Several Viewpoint articles by the Chief Executive with titles such as "Hong Kong's business cycle synchronisation with Mainland China and the US" (September 21, 2006), "Market expectation of renminbi exchange rate movements" (October 5), "The renminbi and the Hong Kong dollar" (November 30) were published during the fall of 2006 and other efforts were also made to communicate to the markets that there was no intention to abandon the link to the US dollar and peg to the renminbi. These efforts appear to have borne fruit by the

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[32] See, for example, Greenwood (2008), p. 289, and Genberg, Liu, and Jin (2006).

end of the year, and when the RMB/USD rate passed through the HKD/USD convertibility zone in the beginning of 2007, it went almost unnoticed by foreign exchange market traders at least as judged by pressures on the spot rate at the time. Furthermore, since this episode the link between the Honk Kong dollar forward rate and the renminbi NDF rate has disappeared (Chart 13).

Chart 13: Forward exchange rates.
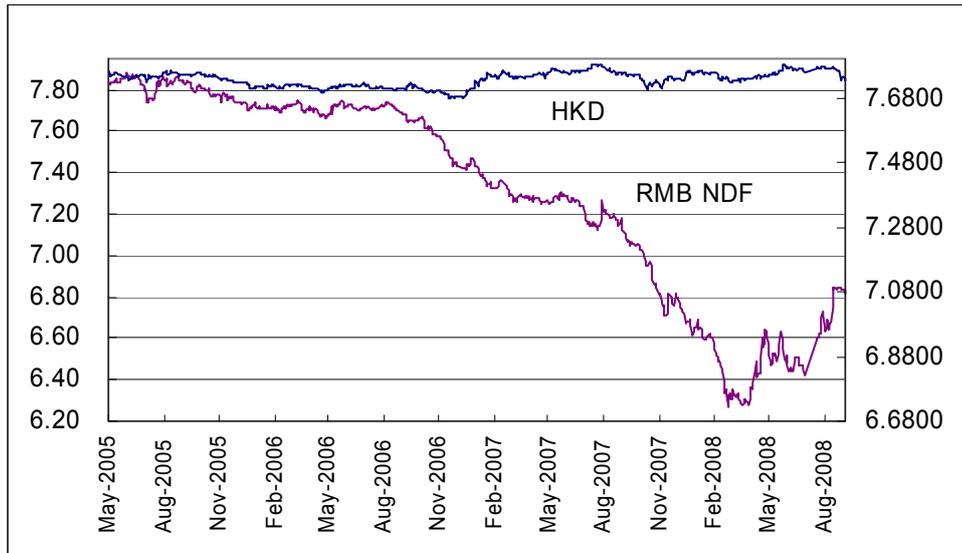
VI. Concluding remarks.

Using methods derived from modern finance theory we have presented evidence showing that reforms of the Linked Exchange Rate System have been well accepted and have had their intended effects as judged both by the behaviour of the exchange rate itself and by various derivative products that incorporate expectations of exchange rate movements. Arguably the system has grown stronger and more credible over time. Part of the reason for this may be that the reforms have always gone in the direction of making the system more rules based and hence less discretionary. But more fundamentally the credibility of the system is surely also related to the supportive strong fiscal position of the government which has meant that there has never been any serious question about the need for financing of government deficit by monetary means. In addition it should be mentioned that prices and wages in Hong Kong are quite flexible which makes the adjustments to shocks less costly than they otherwise would

be.[33] These underlying factors bode well for the continuation of Hong Kong' fixed exchange arrangement.

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[33] See Pauwels and Zhang (2008) on wages and Yetman (2008) on prices.

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