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WHAT DRIVES HONG KONG DOLLAR SWAP SPREADS: CREDIT OR LIQUIDITY?

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Abstract

This paper investigates the determinants of variations in the yield spreads (swap spreads) between Hong Kong dollar interest rate swaps and Exchange Fund paper for a period from July 2002 to April 2008. A vector error-correction model is used to analyse the impact of various shocks on swap spreads. The issue is whether "liquidity" or "credit" (or both) is the main determinant of swap spread dynamics. The results show that the dynamics are influenced significantly by "credit" between July 2002 and September 2007. However, "liquidity" between the Exchange Fund long-term notes and short-term bills is the major determinant of swap spreads between September 2007 and April 2008. The substantial demand of the Exchange Fund short-term bills, that reflected the strong preference of market participants for holding short-term instruments for liquidity purposes probably due to the sub-prime crisis in the US, is the driving force of the rise in swap spreads in the last quarter of 2007.

JEL classification: G15, E43
Keywords: Hong Kong dollar interest rates, swap spreads, vector error-correction model, sub-prime crisis

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Executive Summary

- *Markets interpret swap spreads as an "effective proxy for banking liquidity". This paper investigates the determinants of variations in the swap spreads between Hong Kong dollar interest rate swaps and Exchange Fund paper for a period from July 2002 to April 2008. A vector error-correction model is used to analyse the impact of various shocks on swap spreads. The issue is whether "liquidity" or "credit" (or both) is the main determinant of swap spread dynamics.*

- *The results show that the dynamics are influenced significantly by "credit" between July 2002 and September 2007. However, "liquidity" between the Exchange Fund long-term notes and short-term bills is the major determinant of swap spreads between September 2007 and April 2008. The liquidity factor drove the rise in swap spreads to about 200 basis points in the last quarter of 2007. There is no empirical evidence to show that the global credit concern may have led to banks in Hong Kong using their surplus funds to purchase Exchange Fund paper rather than lending them to other banks in the interbank market.*

- *The convenience yield of holding the Exchange Fund three-month bill that measures the relative liquidity between the Exchange Fund two-year note and the three-month bill is a more appropriate indicator of the market liquidity condition than HIBOR in this context. Liquidity in the form of Exchange Fund paper is different from liquidity in the form of interbank lending. Moreover, liquidity of Exchange Fund paper with different maturities is considered by market participants to be different. That has made the Exchange Fund short-term paper the primary instrument for liquidity purposes and increased its demand substantially since September 2007 when the sub-prime crisis in the US emerged.*

- *An increase in the supply of Exchange Fund short-term paper, consistent with the Currency Board rule of 100% US-dollar backing for the Monetary Base, should be an effective method to reduce the convenience yield of the Exchange Fund short-term paper and thus reduce the swap spread as well. A drop in the swap spread indicates that tightened liquidity condition in the interest rate market is resolved to some extent.*

I. INTRODUCTION

A swap is an agreement between two parties to exchange cash flows in the future. The most common type of swaps is a 'fixed-for-floating' interest rate swap where one party receives floating (variable) interest rate payments over a given period and is willing to pay the other party a fixed (swap) rate to receive those floating payments. The volume of Hong Kong dollar interest rate swap transactions is high in the over-the-counter market.[2] Differences between swap rates and corresponding Exchange Fund paper yields of the same maturity are referred to as swap spreads.

Markets interpret swap spreads in two different ways. First, it is an "effective proxy for banking liquidity". As the formal derivation of the swap rate is an average of future inter-bank offer rates, the spreads reflect the different funding costs (i.e. liquidity premiums paid by banks) of a government and banks. A second interpretation is that the spreads are mostly a proxy for the AA- credit spreads. While there are papers investigating the determinants of US dollar swap spreads to establish the relationship between the spreads and "liquidity" or "credit" (see Duffie and Singleton (1997); Huang et al. (2002); Feldhütter and Lando (2008)), to our best knowledge, no publication on investigating appropriate explanation of Hong Kong dollar swap spreads can be found in the literature.[3]

In addition to filling the gap in the literature, an interesting issue has emerged in the Hong Kong dollar bond and swap markets since the second half of 2007 – the divergence between the swap rates and the yields of corresponding Exchange Fund paper.[4] Chart 1 illustrates this by showing the two-year swap spreads. The divergence started some time in August 2007, widening from about 50 basis points to about 200 basis points in December 2007. There is likely a structural break of the time series of the swap spreads at that period of time.

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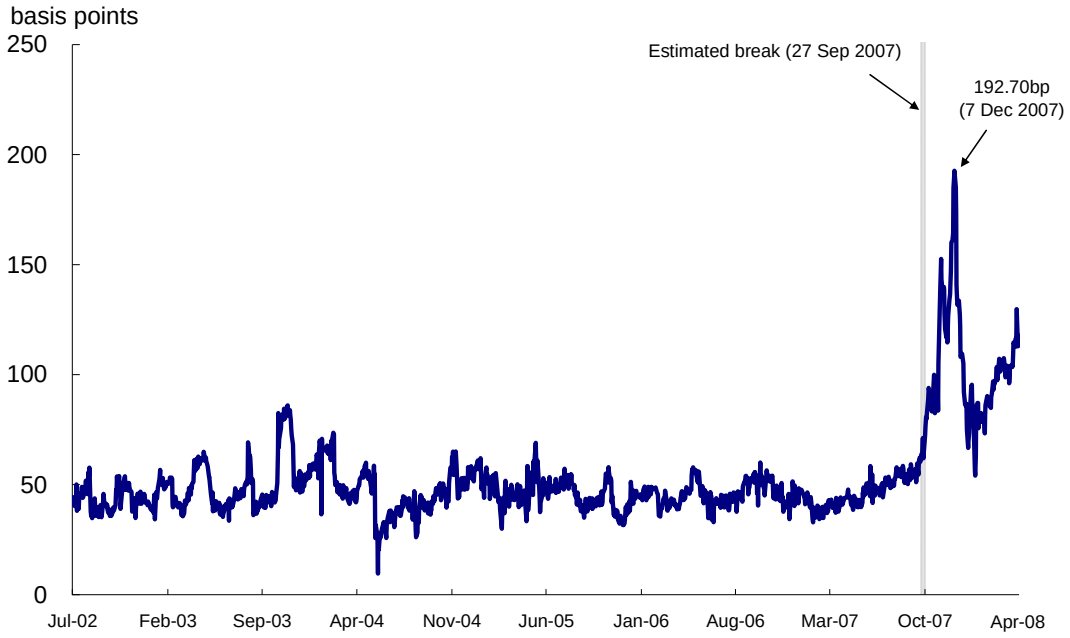
[2] According to BIS Triennial Central Bank Survey of Foreign Exchange and Derivatives Market Activity in April 2007, the daily average turnover of interest rate swap transactions in the Hong Kong dollar is US$8,778 million (see Bank for International Settlements (2007)).

[3] Huang et al. (2008) investigate the extent of swap curve dynamics across the Hong Kong dollar and US dollar, but do not discuss the corresponding swap spreads.

[4] See Yam (2007).

Chart 1. Two-Year Hong Kong Dollar Swap Spread



The rise of the Hong Kong dollar swap spreads coincides with the emergence of the sub-prime crisis in the US during the second half of 2007. The credit concern arising from the crisis has made leading financial institutions in the US and Europe much more cautious in lending surplus funds in the money markets. In Hong Kong this credit concern may have led to banks using their surplus funds to purchase Exchange Fund paper rather than lending them to other banks in the interbank market including the interest rate swap market. Apart from the credit concern, there was increasing demand for interbank liquidity to cope with the surge in interbank transactions arising from buoyant primary and secondary stock-market activity in same period of time.[5] In this paper, we try to see which factor or factors drive the Hong Kong dollar swap spreads by using a vector error-correction (VEC) model.

We study the time series dynamics of swap spreads, the Hong Kong Interbank Offered Rate (HIBOR), credit spreads of Hong Kong dollar non-government bonds, Exchange Fund paper yield curve and US interest rate, in order to determine the effects of these factors on swap spreads individually. The use of daily data on the time series permits us to separate out explicitly the effect of credit spread movements from liquidity considerations.

[5] The turnover of Hong Kong dollar real time gross settlement transactions in the interbank market has been rising, frequently surpassing $1.2 trillion a day in October and November 2007, and reaching a record $1.67 trillion on 5 November 2007.

The rest of the paper is organised as follows. In the following section, we discuss the choices of explanatory variables and the sources of daily data. Section III presents break points tests for the time series of the swap spreads. The empirical findings of the swap spread dynamics are reported in Section IV. The discussion and conclusion of the findings are in Section V.

II. EXPLANATORY VARIABLES AND DATA

The two-year Hong Kong dollar swap spread is examined in this study. As the swap rates are quoted with coupon-payments on a quarterly basis while the coupon-payments of the Exchange Fund paper are on a semi-annual basis, the swap rates are adjusted to an equivalent semi-annual basis. The swap spread is derived by subtracting the yield of the Exchange Fund two-year note from the adjusted two-year swap rate. The variables included in the analysis of swap spread dynamics are swap spreads (SWAPHK), six-month HIBOR (HIBOR), yield spreads between the Exchange Fund two-year note and three-month bill (SLOPEHK), credit spreads of Hong Kong dollar non-government bonds (CREDIT), and two-year US Treasury yield (YUS). Since the data of the Hong Kong HSBC Bond Indices used for estimations of credit spreads are available from 2 July 2002, the data used for this paper are daily data from this day to 30 April 2008.[6] This section explains the reasons of choosing these variables.

Liquidity risk is a plausible explanation for swap spreads. In this paper, the six-month HIBOR (see Chart 2) and the spread between the yields of the Exchange Fund two-year note and three-month bill (see Chart 3) are the proxies for liquidity risk.[7] As HIBOR is the return required by a lending bank to provide liquidity in the interbank market, it reflects the general interbank liquidity condition. The spread between the yields of the Exchange Fund two-year note and three-month bill is a proxy for a convenience yield of holding the Exchange Fund three-month bill associated with its liquidity. The concept of the convenience yield as an explanation for swap spreads is introduced by Grinblatt (2001).[8] The two-year note price F can be interpreted as an average future price of the three-month bill price S over time T of 21 months such that:

$$F = Se^{-cT}$$

where c is the convenience yield which simply measures the extent to which the future price (the left-hand side) is less than the current price (the right-hand side).

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6 All data are obtained from Bloomberg.

7 The HIBOR-LIBOR spread is sometimes quoted as an indicator of market liquidity. However, the preliminary results show that it is not a significant explanatory variable.

8 Duffie and Singleton (1997) use the spread between the generic three-month repo rate for the ten-year Treasury note and the repo rate of the current on-the-run Treasury note. However, the repo market for the Exchange Fund paper is not active.

Chart 2. Six-Month HIBOR

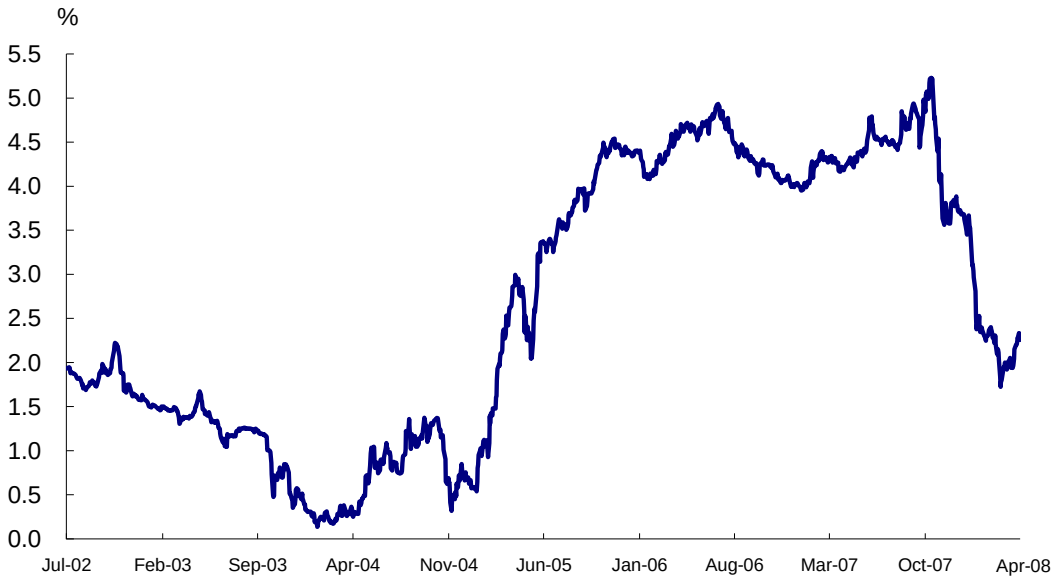

Chart 3. Yield Spread between Exchange Fund Two-Year Note and Three-Month Bill

The convenience yield reflects the market's expectations concerning the future demand or surge in price of the three-month bill. The greater the possibility that surge in demand or price will occur in the future, the higher the convenience yield. If investors of the three-month bill have high inventories, there is very little chance of huge demand in the near future and the convenience yield tends to be low. Banks hold substantial amounts of Exchange Fund paper for use in the automatic intra-day repurchase arrangement (repo) with the Hong Kong Monetary Authority for intra-day liquidity to settle interbank payments. There is a hair-cut of 2% per year of the remaining maturity of the Exchange Fund paper. When the liquidity is tight and banks expect to use the repo more frequently, banks may prefer to hold short-term paper instead of long-term paper in order to have lower hair-cuts and the convenience yield increases accordingly.

Another plausible factor to drive the swap spread is credit risk which is proxied by the credit spreads of Hong Kong dollar non-government bonds. The credit spread shown in Chart 4 is the difference between the yield of the Exchange Fund paper and the aggregate yield of the non-government bonds with the same modified duration.[9] The aggregate yield of the non-government bonds are given by the Hong Kong HSBC Bond Index which is a market capitalisation weighted return of single A or equivalent Hong Kong dollar non-government bonds of maturity within one to three years.[10] The weighted modified duration of the constituent bonds of the index is used to match the corresponding Exchange Fund paper in order to obtain the credit spread associated with the non-government bonds. If the modified duration of the non-government bond ($MD_{hkdb,t}$) exactly matches with the modified duration of Exchange Fund paper (MD_{efbn}), the credit spread on day *t* is the difference between their yields. If the $MD_{hkdb,t}$ does not exactly match the MD_{efbn} of any Exchange Fund paper, a linear interpolation method is used to obtain the yield of the corresponding non-government bond based on the yields of Exchange Fund paper where the $MD_{hkdb,t}$ falls between their MD_{efbn}.

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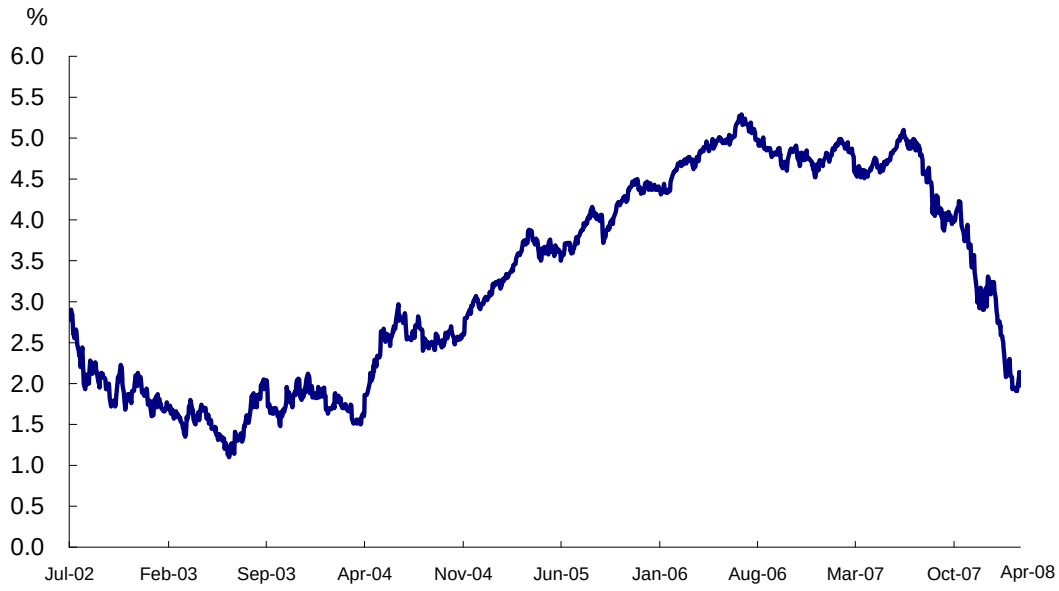
9 The duration of a bond, *D*, is $\sum_{i=1}^{n} t_i c_i e^{-yt_i} / B$ where *n* is the maturity in years, c_i is the coupon payment at t_i ($1 \le i \le n$), *y* is the yield (continuous compounded), and *B* is the bond price calculated as $B = \sum_{i=1}^{n} c_i e^{-yt_i}$. The modified duration is $D/(1+y^*/m)$ where y^* is the yield expressed in a compounding frequency *m* times per year.

10 The Hong Kong HSBC Bond Index is one of the HSBC Asian Local Bond Indices. The details about the indices are at http://www.hsbcnet.com/research/asian-local-bond-index.

Chart 4. Credit Spread of Hong Kong Dollar Non-Government Bonds

As the Hong Kong dollar is pegged to the US dollar and thus the US Treasury yield would impact the Hong Kong dollar swap spreads to some extent, the two-year US Treasury yield shown in Chart 5 is used to represent US interest rate.

Chart 5. Two-Year US Treasury Yield



III. BREAK POINT TEST

As shown in Chart 1, the time series of the swap spreads (SWAPHK) is likely to have structural changes as the sample period covers some important events including the implementation of the three refinements of the Linked Exchange Rate system in May 2005, the US sub-prime crisis emerged in August 2007, and a very large injection of interbank liquidity in early November 2007 as a result of the triggering of the strong-side Convertibility Undertaking.[11]

We use the *supF*-type test proposed by Bai and Perron (1998, 2003) to test the presence of abrupt structural changes in the series SWAPHK. Serial correlation and heteroskedasticity in the residuals are taken into account in the estimation of the break dates. The results of the number of breaks and the break dates are shown in Table 1. The result of the $SupF_T(k)$ test as shown on the first row of Table 1 indicates that the null of no structural break against the alternative of *k* breaks are rejected for *k* between 1 and 5. As the UDmax and WDmax statistics are highly significant and hence reject the null of no structural break, the results show that there is at least one break.

[11] The details of the three refinements: are at http://www.info.gov.hk/hkma/eng/press/2005/20050518e4_index.htm.

Table 1. Results of Break Point Test

Tests				
$SupF_T(1)$	$SupF_T(2)$	$SupF_T(3)$	$SupF_T(4)$	$SupF_T(5)$
13.2799***	8.8193**	10.5465***	7.7857***	8.6108***
$SupF(2\|1)$	$SupF(3\|2)$	$SupF(4\|3)$	$SupF(5\|4)$	
3.9232	16.4311***	2.4721	11.3208*	
UDmax	WDmax			
13.2799***	17.2747***			

Notes:
1. The test is applied with the maximum number of breaks m = 5 and a trimming parameter ε =0.1. The trimming parameter is responsible to the asymptotic distribution taken in the $SupF_T(k)$ test. Since heterogeneity and autocorrelation is allowed in the residuals, Bai and Perron (2003) suggest that a value of ε higher than 0.05 should be used. With the consideration of the large sample size in this study (T = 1390), a value of 0.1 is chosen. Details of the suggestions of the specification of the test can be found in Bai and Perron (2003).
2. The $SupF_T(k)$ test tests the null of no break versus k breaks. A rejection indicates the presence of k breaks. The reported standard errors and confidence intervals allow for the possibility of serial correlation in the disturbances.
3. The $SupF(\ell+1|\ell)$ test is a test for ℓ versus $\ell+1$ breaks. The method amounts to the application of $\ell+1$ tests of the null hypothesis of no structural change versus the alternative hypothesis of a single change. The sample is divided into $\ell+2$ segments according to previously estimated break dates $\hat{T}_1,...,\hat{T}_{\ell+1}$.The test is applied to each segment containing the observations of $\hat{T}_{i-1}$ to $\hat{T}_i$ (i = 1, …, $\ell+1$). A rejection of the null is in favour of a model with $\ell+1$ breaks.
4. UDmax and WDmax are two tests of the null hypothesis of no structural break against an unknown number of breaks.
5. The break test is implemented in a GUASS program available on the website of Pierre Perron.

Another test is the $SupF(\ell+1|\ell)$ test from which a significant statistic suggests a series with $\ell+1$ breaks. As shown in Table 1, *SupF* (2|1) is not significant while *SupF* (3|2) is significant, therefore the presence of three breaks is likely. However, with a marginally significant *SupF* (5|4) statistic and an insignificant *SupF* (4|3) statistic, the chance of the presence of more than three breaks is marginal. Based on the $SupF(\ell+1|\ell)$ test, the number of breaks is either one or three. The break number is further tested by the sequential method proposed by Bai (1997) with a 5% size, which suggests one structural break.[12] The results show that the series is likely to have one break at 27 September 2007.

[12] Because the Bayesian information criterion of Yao (1988) and modified Schwarz criterion of Liu et al. (1997) cannot take into account potential heteroskedasticity, they are not used to test the number of breaks as financial data are in general subject to heteroskedasticity.

IV. VECTOR ERROR-CORRECTION (VEC) MODEL AND SWAP SPREAD DYNAMICS

The dynamics of the swap spread is studied by a multi-equation model. The advantage of this model over a single equation analysis is that all variables in the system are symmetric without making reference to the issue of dependence and independence. The results of the augmented Dickey-Fuller test in Table 2 show that the series of the five variables (SWAPHK, HIBOR, SLOPEHK, CREDIT and YUS) are non-stationary in level but stationary in first-difference form. They are cointegrated as indicated by the results of the Johansen test shown in Table 3. Because of the above characteristics, a VEC model is employed for the analysis.[13] The VEC model is a multivariate system of equations with error-correction terms in each equation. The VEC model is specified as

$$\Delta y_t = \pi_0 + \pi\ y_{t-1} + \sum_{p=1}^{P} \pi_p \Delta y_{t-p} + \varepsilon_t \qquad (1)$$

where y_t is a (5×1) vector of $(SLOPEHK_t, HIBOR_t, CREDIT_t, YUS_t, SWAPHK_t)$;

π_0 is an (5×1) vector of intercept terms with elements π_{i0};

π is a (5×5) matrix with elements π_{jk} such that one or more of the $\pi_{jk} \neq 0$;

π_i, for $i = 1,\ldots,P$, is an (5×5) matrix with elements $\pi_{jk}(i)$ and is present to tackle serial correlation; and

ε_t is a (5×1) vector of disturbance terms ε_{it}, in which ε_{it} may be correlated with ε_{jt}.

[13] he vector autoregression (VAR) model is not used in this analysis because it is subject to spurious regressions when the variables are nonstationary. Moreover, as the variables involved are tested to be cointegrated, their first differences entail a misspecification error under the VAR framework.

Table 2. Results of Augmented Dickey-Fuller Test

	In Level		In First Difference	
	k	τ -statistic	k	τ -statistic
SWAPHK	13	-3.1401	12	-11.3026***
SLOPEHK	14	-1.3162	13	-8.9882***
HIBOR	13	-1.0049	12	-9.3922***
CREDIT	18	-3.3419	17	-8.4277***
YUS	11	-0.6784	10	-10.4513***

Notes:
1. The augmented Dickey-Fuller test is carried out in the following form:
$$\Delta x_t = \alpha + \beta x_{t-1} + \sum_{j=1}^{k} a_j \Delta x_{t-j} + \varepsilon_t$$
where x is the SWAPHK, SLOPEHK, HIBOR, CREDIT or YUS, k is the number of lagged dependent variables which is chosen by the general-to-specific procedure in Perron (1989) with a maximum value of 20.
2. τ -statistic is calculated by dividing the estimated value by the standard error of β in the above equation. Since the τ -statistic does not follow a normal distribution when $\{x_t\}$ is not stationary, it is tested using the critical values in the Dickey-Fuller table. The critical values taken from Fuller (1976) for the sample size = ∞ for the τ -statistic at the 1%, 5%, and 10% significance level are -3.44, -2.87, -2.57, respectively.
3. *** indicates significance at the 1% level.

Table 3. Johansen Test for Cointegration

	Pre-break Sample		Post-break Sample	
Number of Cointegration Equation(s)	λ_{trace}	$\lambda_{\max}$	λ_{trace}	$\lambda_{\max}$
None	123.8163***	57.8281***	96.6057***	45.8676***
At most 1	65.9882***	34.9873***	50.7380*	23.1839
At most 2	31.0009	16.2238	27.5541	13.7741
At most 3	14.7772	10.9412	13.7801	11.2056
At most 4	3.8360	3.8360	2.5745	2.5745

Notes:
1. The Johansen test employs two statistics, λ_{trace} and $\lambda_{\max}$, to test the number of cointegration equations in a multi-equation system. These two statistics are calculated with the eigenvalues of the matrix π in Equation (1). For details of these two statistics, see Enders (2004).
2. * and *** indicate statistically significance at the 10% and 1% level respectively.

As the variables are cointegrated, they exhibit co-movement towards a long run relationship. In such circumstances Δy_t responds to the previous period's deviation from long-run equilibrium, and hence they should be represented in the VEC form with the presence of the matrix π. Each row of π is a cointegrating vector. When all elements of π are equal to zero, Equation (1) becomes a representation of the vector autoregression model in first differences. Given the break at 27 September 2007, the estimation of the VEC model is carried out with two sub-samples: (i) 2 July 2002 to 26 September 2007; and (ii) 27 September 2007 to 30 April 2008.

The optimal lag *p* is detected by a likelihood ratio (LR) test following a general-to-specific procedure. The LR test in this study starts with a maximum number of *p*. The test is then carried out for a model with *p* lags versus one with *p-1* lags, until *p* equals one. The model with one-more lag is treated as an unrestricted model whereas the model with one-less lag as restricted. A LR-statistic is calculated to test the significance of the imposing the restrictions. A statistically significant LR statistic indicates a reduction of the fit of the restricted model and suggests that the model with one more lag is appropriate.

For the sample before the estimated break, we allow one-month lagged information to enter the system and the maximum number of lags is set to be 30. Regarding the sample after the estimated break, in view of a smaller number of observations, the maximum lag is set as 20.[14] The results of the LR test in the Appendix show that the optimal lag with 5% significance is 26 and 14 for the samples before and after the estimated break respectively.

A perturbation in one variable in the VEC model sets up a chain reaction over time in all the variables. Impulse response functions are estimated to examine the interactions between the dynamics of the variables in the model.[15] The graphical output of the impulse responses of the swap spreads to the variables based on the pre-break and post-break samples are given in Charts 6 and 7 respectively. The shock is set as one positive standard deviation of the residuals of each equation. The responses are traced out for a period of 1000 days. Variance decomposition which provides information of the contributions of individual variables to the forecast error variance of the swap spreads is summarised in Tables 4 and 5. The discussions of the results are in the following subsections 4.1 to 4.3.

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[14] Duffie and Singleton (1997) use eight maximum lags for weekly data and Huang et at. (2003) use 21 for daily data.

[15] The Cholesky decomposition is employed for the estimation of the VEC model to solve over-identification. The order of the variables and the equations in the VEC model affects the results of impulse responses analysis (also see footnote 15 in Huang et al. (2002)). The extent of the ordering effects depends on the magnitude of the correlation among the error terms of the equations. The order considered in this study is YUS, SLOPEHK, HIBOR, CREDIT and SWAPHK. Since we are interested in discovering the potential factors of swap spread, the equation of SWAPHK enters the system last so that all other variables affect SWAPHK contemporaneously. YUS enters first as we assume the domestic factors do not affect the US variable but the US variable has effects on all domestic variables in the presence of the Linked Exchange Rate system. SLOPEHK is the second as we assume it could affect all the other domestic variables in the system. HIBOR is the third as we assume it may not determine the shape of Exchange Fund paper yield curve but has effects on other variables. CREDIT enters as the fourth variable.

Chart 6. Impulse Responses of SWAPHK
(Pre-break sample: 2 July 2002 to 26 September 2007)

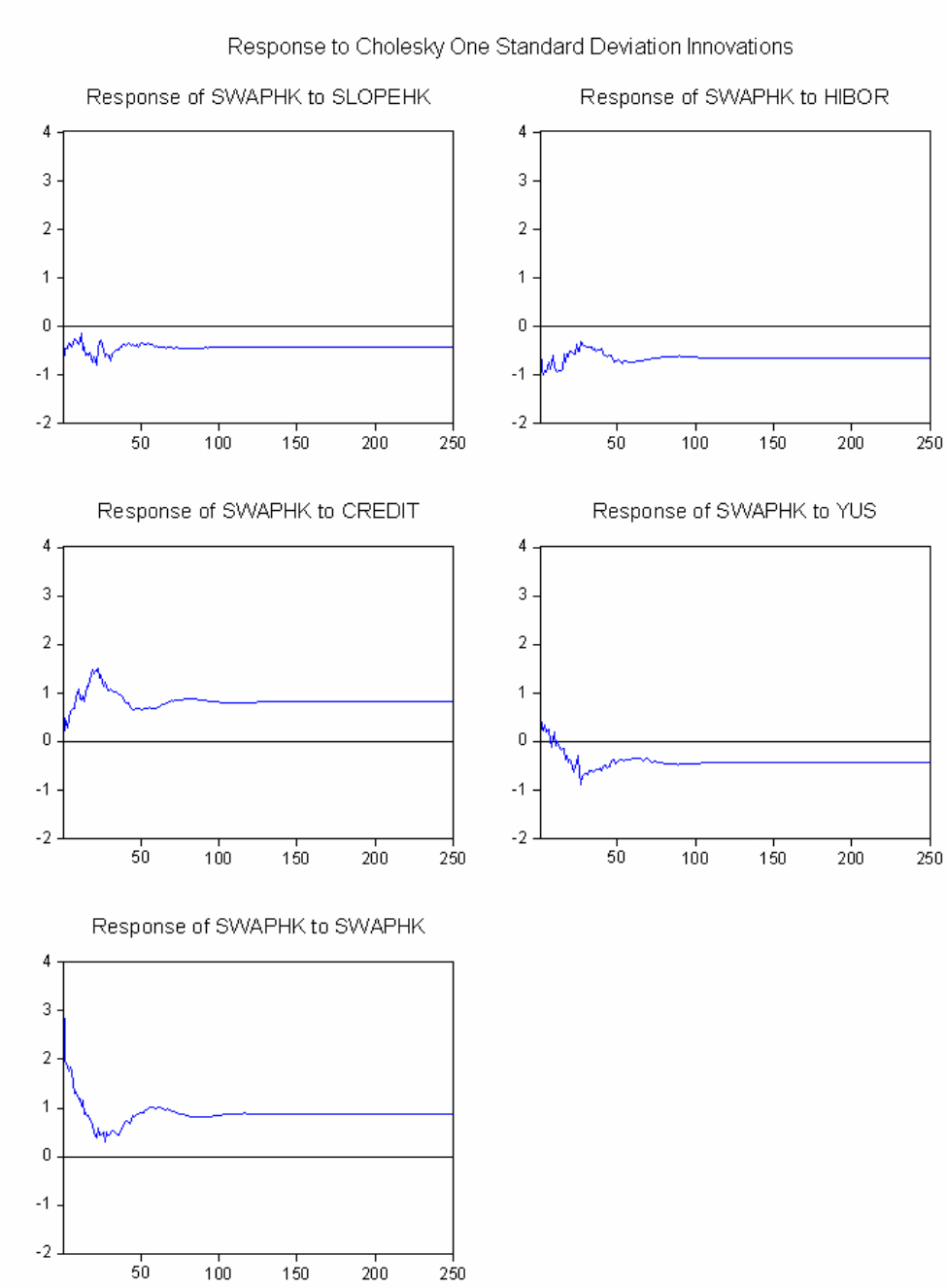

Table 4. Variance Decomposition of SWAPHK
(Pre-break Sample: 2 July 2002 to 26 September 2007)

Horizon (days ahead)	SLOPEHK	HIBOR	CREDIT	YUS	SWAPHK
7	3.94	12.00	4.28	1.47	78.30
28	6.97	13.80	29.47	3.97	45.79
56	7.86	14.89	31.07	7.33	38.85
182	8.25	17.69	29.98	8.06	36.02
364	8.38	18.38	29.81	8.39	35.04
546	8.43	18.63	29.74	8.51	34.69
728	8.45	18.76	29.71	8.57	34.51
1000	8.47	18.86	29.69	8.62	34.36

Chart 7. Impulse Responses of SWAPHK
(Post-break Sample: 27 September 2007 to 30 April 2008)

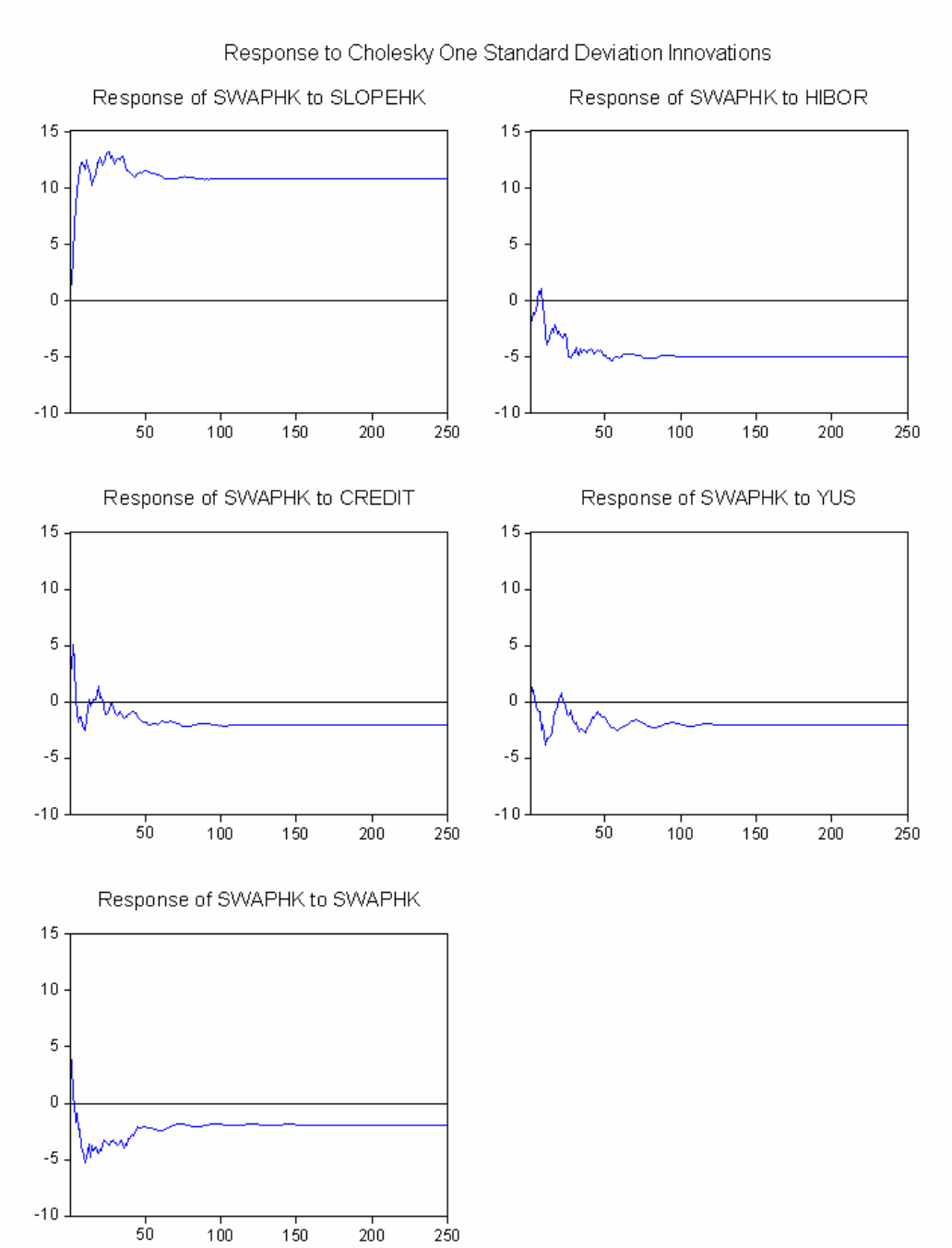

Table 5. Variance Decomposition of SWAPHK
(Post-break Sample: 27 September 2007 to 30 April 2008)

Horizon (days ahead)	SLOPEHK	HIBOR	CREDIT	YUS	SWAPHK
7	82.75	1.87	9.42	0.76	5.19
28	82.40	5.31	1.75	1.99	8.56
56	80.68	9.22	1.46	2.06	6.58
182	77.52	13.89	2.29	2.51	3.80
364	76.70	15.06	2.53	2.62	3.09
546	76.43	15.45	2.61	2.65	2.85
728	76.29	15.65	2.65	2.67	2.73
1000	76.17	15.82	2.69	2.69	2.64

4.1 SLOPEHK and HIBOR

Regarding HIBOR, its effect is comparatively weak through out the periods before and after the break point and it explains only about 10% to 20% of the variance of the swap spreads. This show that HIBOR is not a major driving factor of the swap spreads during the sample period. Similar weak impact of LIBOR on US dollar swap spreads is found by Huang et al. (2002). Charts 6 and 7 show a negative relationship between HIBOR and swap spreads. This is probably because the increase in HIBOR reflects the expectation of rise in interest rates. Under such expectation, financial institutions in particular banks are likely to rebalance their balance sheets by selling Exchange Fund long-term paper and holding Exchange Fund short-term paper, rather than to hedge using the swap market. Such market behaviour drives the long-term including two-year bond yield up and the swap spread then narrows.

Before the break point, the impulse responses indicate that the convenience yield (SLOPEHK) of holding the Exchange Fund three-month bill has a negative effect on swap spreads. Chart 6 shows that the swap spread increases as the convenience yield falls. However, Table 4 shows that convenience yield shock is relative unimportant during the pre-break-point period, that explains less than 10% of the variance of the swap spreads. After the break point, its effect changes significantly. Chart 7 and Table 5 show that the impulse response reverses and the convenience yield explains more than 75% of the variance of the swap spreads for the period. An increase in the convenience yield is accompanied by a significant rise in the swap spread. The results are consistent with the findings in Grinblatt (1995), Duffie and Singleton (1997) and Feldhütter and Lando (2008) regarding the impact of liquidity premiums on US dollar swap spreads.[16] An increase in the convenience yield reflects that market participates prefer holding the three-month bill rather than the two-year note. This indicates that since September 2007 when the liquidity tightened due to the sub-prime crisis, the Exchange Fund short-term paper has become the major liquidity instrument. The convenience yield may thus be a better indicator of the market liquidity condition than HIBOR.[17]

4.2 CREDIT

Before the break point, the impulse responses indicate that credit spreads positively affect swap spreads. Table 4 shows that the credit effects are weak initially but increase in importance over the longer horizon. They explain about 30% of the variance of the swap spreads in the time beyond 28 days. This finding is consistent with that in

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[16] While the measures of convenience yields are different in their works, the objective of those measures is to estimate the impact of liquidity premiums on swap spreads in the interest rate market.

[17] When the data series are extended to 30 August 2008, the impulse responses indicate that the convenience yield explains only 6% of the variance of the swap spreads in the time beyond 56 days. This reflects that the liquidity condition eased during the period between April and August 2008. The results are not presented here but are available upon request. Also see footnote 18 below.

Duffie and Singleton (1997) and Lang et al. (1998) regarding US dollar swap spreads. This means that counterparty default risk is an important determinant of the Hong Kong dollar swap spreads during the period before September 2007.

By contrast, the credit effects can be ignored during the sample period after September 2007. They only explain about 2% of the variance of the swap spreads in the time beyond 28 days.[18]

4.3 YUS

As the Hong Kong dollar is linked to the US dollar, the two-year US Treasury rate will positively influence both Hong Kong dollar swap rates and yields of Exchange Fund paper. During the sample period (before and after the break point), the impulse responses indicate that the US Treasury yield has a negative effect on swap spreads. This reflects that when the US interest rate increases, the yields of the Exchange Fund paper increase more than the swap rates such that the swap spreads decrease. Similar to the market response to the increase in HIBOR, financial institutions are likely to rebalance their balance sheets by holding of Exchange Fund short-term paper and selling long-term paper, instead of hedging using interest rate swaps. Such response causes the swap spread to narrow.

The US interest rate accounts for less than 9% of the variance of the swap spreads before the break point and enters as an insignificant component in the variance decomposition of swap spreads after the break point.

V. DISCUSSION AND CONCLUSION

We have investigated whether factors, such as liquidity and credit, are determinants of the swap spreads between the two-year Hong Kong dollar swap rates and Exchange Fund note yields. To assess the relative importance of the convenience yield of the Exchange Fund three-month bill, HIBOR, credit spreads and US interest rate, a VEC model is used for the analysis.

The empirical results show that there is a structural break of the series of the two-year swap spreads at 27 September 2007. The determinants of the swap spreads before and after are very different. Before the break (i.e. the period from 2 July 2002 to 26 September 2007), the credit spread of single A or equivalent Hong Kong dollar non-

[18] When the data series are extended to 30 August 2008, the impulse responses indicate that the credit spreads explain about 60% of the variance of the swap spreads. This means that counterparty default risk was again an important determinant of the Hong Kong dollar swap spreads during the period between April and August 2008. The results are not presented here but are available upon request.

government bonds is the main determinant of swap spreads that explains about 30% of the variance decomposition of swap spreads at time horizons of 28 days and beyond. A widening of credit spreads is associated with a widening of swap spreads. It is consistent with a view that swap spreads reflect the counterparty default risk of swap contracts. On the contrary, the liquidity and US interest rate are relatively unimportant.

The determinants of the swap spreads change substantially after the break point (i.e. the period from 27 September 2007 to 30 April 2008). Chart 4 shows that the credit spread triggered by the sub-prime crisis increased substantially during the period between October and December 2007. Compared to the movement of the spread swap in Chart 1, the credit spread seems to be an important determinant. However, the results indicate that credit spreads are unimportant for determining the swap spreads' variation. This means that counterparty default risk is not a primary concern in the swap market after the break point. There is no empirical evidence to show that the global credit concern may have led to banks in Hong Kong using their surplus funds to purchase Exchange Fund paper rather than lending them to other banks in the interbank market.

The alternative explanation is one of increasing demand for interbank liquidity. However the effect of HIBOR is comparatively weak and has a negative relationship with swap spreads. Its week effect can be explained by the opposite forces arising from the surge in interbank transactions arising from buoyant primary and secondary stock-market activity during October and November 2007, and a very large injection of interbank liquidity in early November as a result of the triggering of the strong-side Convertibility Undertaking, causing the Aggregate Balance to increase from $1.3 billion to $10.6 billion, that would have provided banks with ample liquidity.

The convenience yield of the Exchange Fund three-month bill that measures the relative liquidity between the Exchange Fund two-year note and three-month bill is a more appropriate indicator of the market liquidity condition than HIBOR in this context. It has been the major determinant of the swap spread dynamics since September 2007. Liquidity in the form of Exchange Fund paper is different from liquidity in the form of interbank lending. Moreover, liquidity of the Exchange Fund paper with different maturities is considered by market participants to be different, that makes the Exchange Fund short-term bills the primary instruments for liquidity purposes and increases its demand substantially.[19] Therefore, an increase in the supply of Exchange Fund short-term paper, consistent with the Currency Board rule of 100% US-dollar backing for the Monetary Base, should be an effective method to reduce the convenience yield of the Exchange Fund short-term paper and thus reduce the swap spread as well. A drop in the

[19] The demand was so great that the Exchange Fund short-term bills had a negative yield, which means that the banks were even prepared to pay for holding them, instead of just sitting on the money in their clearing accounts.

swap spread indicates that tightened liquidity condition in the interest rate market is resolved to some extent.

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Appendix: Likelihood Ratio Test for Optimal Lag Length of VEC Model

	Pre-break Sample		Post-break Sample	
Lag Length	LR statistic	P-value	LR statistic	P-value
30 vs 29	22.4278	0.6109		
29 vs 28	17.2513	0.8725		
28 vs 27	24.0741	0.5151		
27 vs 26	30.7529	0.1973		
26 vs 25	48.1068	0.0036[a]		
25 vs 24	18.5278	0.8192		
24 vs 23	26.7031	0.3709		
23 vs 22	34.0709	0.1064		
22 vs 21	21.9134	0.6407		
21 vs 20	37.2069	0.0552		
20 vs 19	30.6909	0.1995	31.3556	0.1775
19 vs 18	47.1009	0.0048	25.5658	0.4310
18 vs 17	31.0192	0.1884	20.1057	0.7413
17 vs 16	25.5257	0.4332	17.9328	0.8452
16 vs 15	33.0772	0.1291	21.5071	0.6640
15 vs 14	35.0708	0.0869	20.2635	0.7329
14 vs 13	26.0730	0.4037	40.0849	0.0286[b]
13 vs 12	24.2490	0.5050	16.0165	0.9143
12 vs 11	36.8901	0.0591	22.4255	0.6111
11 vs 10	26.2412	0.3948	49.5201	0.0024
10 vs 9	27.2658	0.3427	37.6885	0.0496
9 vs 8	21.6762	0.6544	39.5501	0.0324
8 vs 7	38.4766	0.0415	24.4037	0.4962
7 vs 6	27.4872	0.3320	19.0986	0.7924
6 vs 5	26.5082	0.3809	24.4527	0.4934
5 vs 4	22.5164	0.6058	29.6775	0.2366
4 vs 3	34.0005	0.1079	21.8673	0.6434
3 vs 2	55.2913	0.0005	48.8910	0.0029
2 vs 1	821.0230	0.0000	89.4295	0.0000

Note: 1. *a*, *b* indicate that the corresponding LR statistic is statistically significant at the 1% and 5% level respectively.