HONG KONG MONETARY AUTHORITY

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*INTEREST RATE RISK IN THE PRICING OF BANKS' MORTGAGE LENDING**

Key Points:

- *Residential mortgage rates in Hong Kong have fallen to a historic low level since late 2004, largely because of severe competition and the prevailing exceptionally low funding cost of the banks. Because of the abundance of liquidity in the banking system, HIBOR is at an abnormally deep discount to LIBOR of about 200 bps. Under the Currency Board arrangements, HIBOR tracks LIBOR closely in the long run. The average HIBOR-LIBOR differential for the past 16 years is near zero.*

- *However, with US interest rates rising, and given the long repayment period of mortgages, there are risks of a reduction on the interest rate margin for mortgage loans made under the prevailing monetary conditions.*

- *Such risks could arise from a narrowing of the average spread between Hong Kong's best lending rate and the cost of funds during the tightening phase of US interest rates, and a shift of the risk premium of Hong Kong dollar over the US dollar to a more normal level.*

- *For simplicity, loans are classified into three groups for analytical purposes to assess these risks: HIBOR-financed loans, time deposits-financed loans and loans financed by an average mix of time, demand and savings deposits. Currently, banks are generally pricing mortgage loans at BLR –2.75% and providing cash rebates of 1% of loan amounts, with a gross mortgage margin of 130 bps for HIBOR-financed lending and 163 to 167 bps for deposits-financed loans.*

- *Simulations derived under different scenarios of interest rate upswings and risk premium reversals indicate that such a margin reduction on loans priced on the currently very low funding cost could be tangible. When HIBOR converges with LIBOR, and assuming US interest rates to increase by 120 bps in the next 12 months as expected by the market, the gross margin of mortgage loans would be reduced because of the lead-lag relationship among the rises in the various interest rates including BLR, and their different responses to the shocks. Taking account of the deposit-acquiring cost (30 bps), operating cost (30 bps) and credit cost (10 bps), the mortgages which are financed by time deposits or with a mix of customers' deposits are expected to maintain a positive, albeit thinner, margin.*

- *The expected tightening of the mortgage spread is likely to exert pressures on the earnings of the banking industry. How the margin of mortgage portfolio and earnings of individual banks may be affected depends much on the structure of their own funding sources and actual operating and credit costs. Note that many of the banks involved in the mortgage market have a sizeable retail deposit base.*

*The analysis of this paper covers the market situation up to January 2005, and uses data up to that month. Since then the market situation has changed, with banks raising their effective mortgage rates, along with the narrowing of risk premium of Hong Kong dollar over the US dollar to a more normal level.

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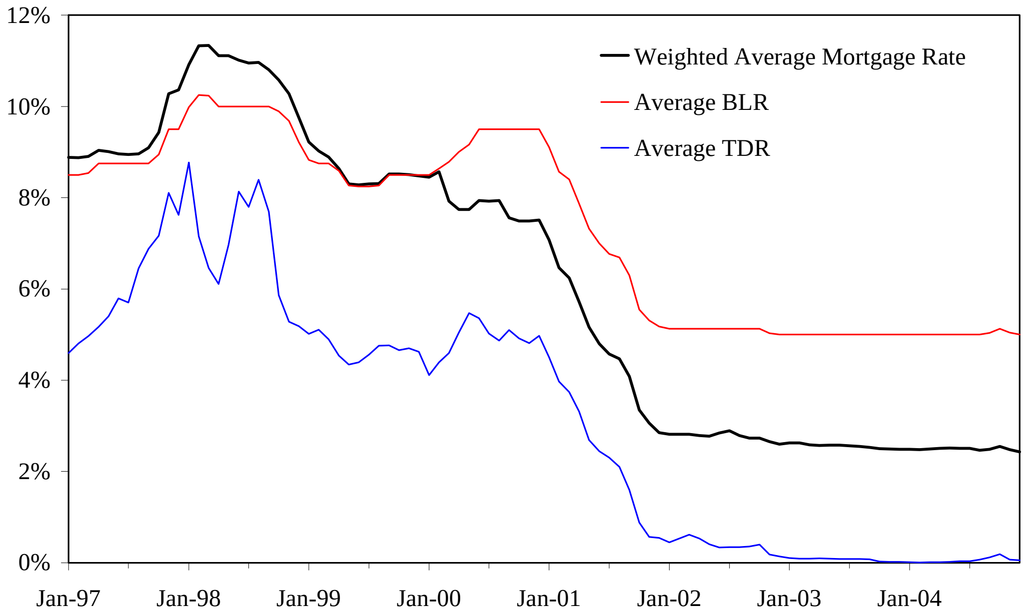
I. INTRODUCTION

Intensive competition among banks in Hong Kong has driven the effective mortgage interest rates down to a historic low of around 2.75% below best lending rate (BLR) with cash rebates of 1% of loan amounts in general since early December 2004.[1] This, together with falling interest rates, has brought the average mortgage rate down gradually from over 11% in early 1998 to just over 2% in December 2004 (see Chart 1). One key reason why banks can offer such low rates is their extraordinarily low funding cost. The spread of BLR over 3-month Hong Kong interbank offered rate (HIBOR) has been maintained at around 460 basis points (bps) since September 2003, as a result of the abundance of liquidity in the banking sector. At the same time, customers' deposit rates have also been at very low levels. On average, the spreads of BLR over the average time deposit rate (TDR) and the effective deposit rate (EDR) have been about 500 bps.[2]

Chart 1. Average Mortgage Rate and BLR



Sources: CEIC and HKMA staff estimates.

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1 In Hong Kong, mortgage rates are set by individual banks. The majority of mortgage loans are adjustable-rate mortgages and the rate is commonly referenced to BLR with a markup, which account for about 96% of new loans approved. The average mortgage rate has come down from around BLR plus 1% in mid-1998 to around BLR minus 2.75% since early December 2004. Taking into account also the cash rebate and other benefits offered by banks, the mortgage rate is estimated conservatively at around BLR minus 3%, assuming a full amortisation period of three years for the cash rebates. Note that the effective mortgage pricing will become BLR-2.75% by the fourth year of the loans when the cash rebates are fully amortised (see Annex I).

2 This refers to interest rates that banks offer to non-bank customer deposits. The TDR is the average rate of time deposits weighted by different maturity composition. The EDR is the average interest rates on demand, savings and time deposits weighted by the deposit composition of the entire banking sector.

The keen competition and high liquidity have benefited home mortgage borrowers. However, given the long repayment period of mortgages, for loans priced on the currently very low funding cost, there are risks of a reduction on the interest rate margin in the time ahead and over their mortgage life. These risks could arise from the following two sources:

(1) Historically, the average BLR – HIBOR spread narrows during periods of increasing interest rates. Looking forwards, therefore, as US interest rates continue to move upwards, spreads are expected to decline, other things being equal.

(2) The currently very loose monetary conditions are not expected to be permanent. The HIBOR will eventually return to a level close to US dollar interbank rates, from its current level of a substantial discount. When this happens, the BLR – HIBOR spread will revert back to the more normal level.[3] It is even possible that the spread could become smaller than the normal level during the lifetime of the current mortgage pool.

Banks are thus faced with interest rate risk, and in this case the basis risk in particular, which could affect banks' net interest margin through changes in the spread between rates earned (the mortgage rate) and rates paid (the HIBOR or deposit rates).[4] Given that mortgage lending represents a significant component of bank assets, how banks are affected by the interest rate risk is therefore an issue of interest.[5]

This study looks at the historical BLR – HIBOR spread and its behaviour during different phases of an interest rate cycle, as well as the movement of the risk premium of Hong Kong interest rates over US rates, and illustrates how the above risks may affect the interest rate margin of banks' current mortgage portfolio. A distinction is made between mortgage loans that are funded on the interbank market and those that are funded by customers' deposits. Using estimates of a cointegration and error correction model, the study also attempts to quantify the impact, by simulating different scenarios of interest rate upswing and risk premium reversal. It is found that loans priced on the basis of the current low funding cost could face a tangible reduction in their interest rate margin.

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3 A normal level in this study refers to a BLR-HIBOR spread in a situation where HIBOR is close to the corresponding interbank interest rate of US dollar.

4 The HIBOR, which is the wholesale money market rate, normally represents the interest cost for wholesale and foreign banks. On the other hand, for banks that have large retail deposit base, their interest cost is dominated by the interests paid on customers' deposits. It should, however, be noted as far as total funding cost is concerned, while the interest rates of customers' deposits are usually lower than HIBOR, a significant acquiring cost, as part of the funding cost, is required to obtain customers' deposits. See footnote 26 for a detailed discussion.

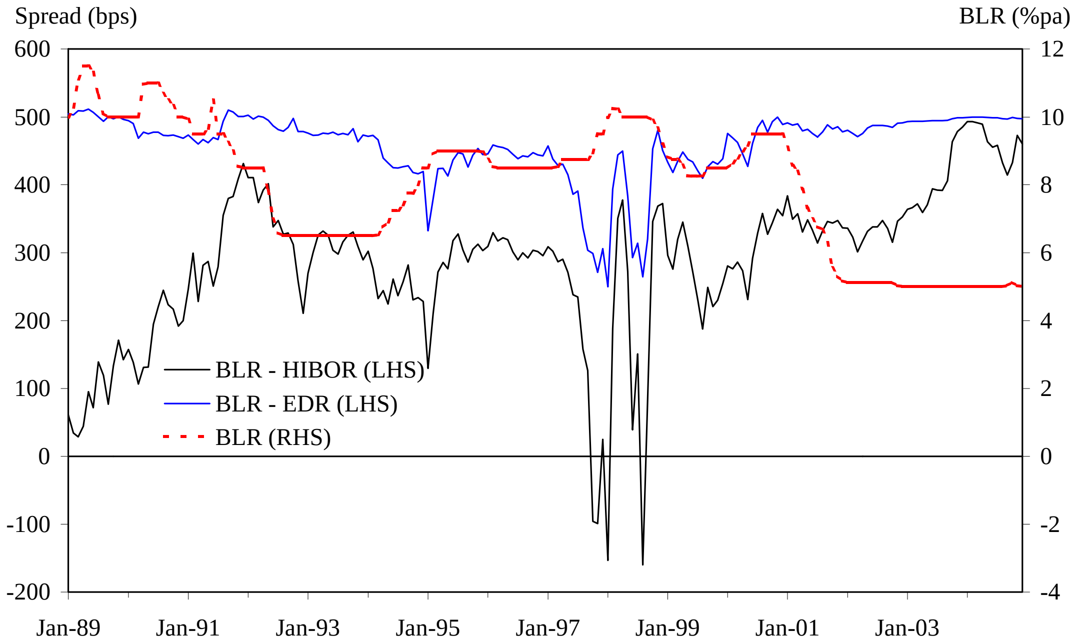
5 As at end-November 2004, mortgage loans accounted for 29% of total loans and advances for use in Hong Kong.

The paper is organised as follows. Section I examines the narrowing of interest margin during the tightening phase of an interest rate cycle. Section II discusses the possible shift in the risk premium. Section III assesses the potential reductions in the interest margin under different scenarios, based on the estimation results of an error correction model. Conclusions are provided in the final section.

II. Narrowing of Spread during the Tightening Phase of Interest Rate Cycle

The average BLR – HIBOR spread in the past 16 years (January 1989 to December 2004) is 300 bps. For the easing phases of the interest rate cycles during the period, the average spread was 310 bps. In contrast, in the tightening phases of the cycles, the average spread was much tighter at 250 bps (Chart 2).[6, 7]

Chart 2. Interest Spreads and BLR



Sources: CEIC and HKMA staff estimates.

[6] The spreads discussed in this section exclude those occurred during the Asian financial crisis and the "double-market play" episode (from October 1997 to September 1998).

[7] The average spread of 250 bps during the tightening phases of the interest rate cycles is statistically smaller than the average spread of 310 bps during the easing phases at 5% significance level.

One often cited reason for the narrowing of spread during the rate tightening phase is that Hong Kong's market rates tend to incorporate expected BLR increases ahead of actual BLR adjustments. This is because HIBOR is very responsive to changes in US market rates, while BLR normally only adjusts when there is a change in the US Federal funds target rate or when pressures from changes in cost of funds are built up to a certain level.[8]

To examine the hypothesis that Hong Kong's market rates move ahead of BLR, joint tests of cross-correlations and Granger causality test are conducted. Details of the tests are presented and discussed in Annex II. The results confirm that the observed narrowing of spread during the tightening phase of interest rate cycle was partly due to the lead-lag relationship between HIBOR and BLR in their response to US interest rate adjustments. A graphical illustration of the lead-lag relationship and the narrowing of the spread is given in Annex III.

III. SHIFT IN RISK PREMIUM

Under the Currency Board system, interest rates in Hong Kong have to track closely their US counterparts. Short-term deviations in interest rates reflect the risk premium of Hong Kong dollar over the US dollar. Since June 2003, HIBOR has been at a consistent discount relative to LIBOR (Chart 3), averaging 94 bps from June 2003 to December 2004, and 200 bps in the past two months.[9] However, the current difference is not expected to be permanent. HIBOR will eventually return to a level close to interbank rates of the US dollar.

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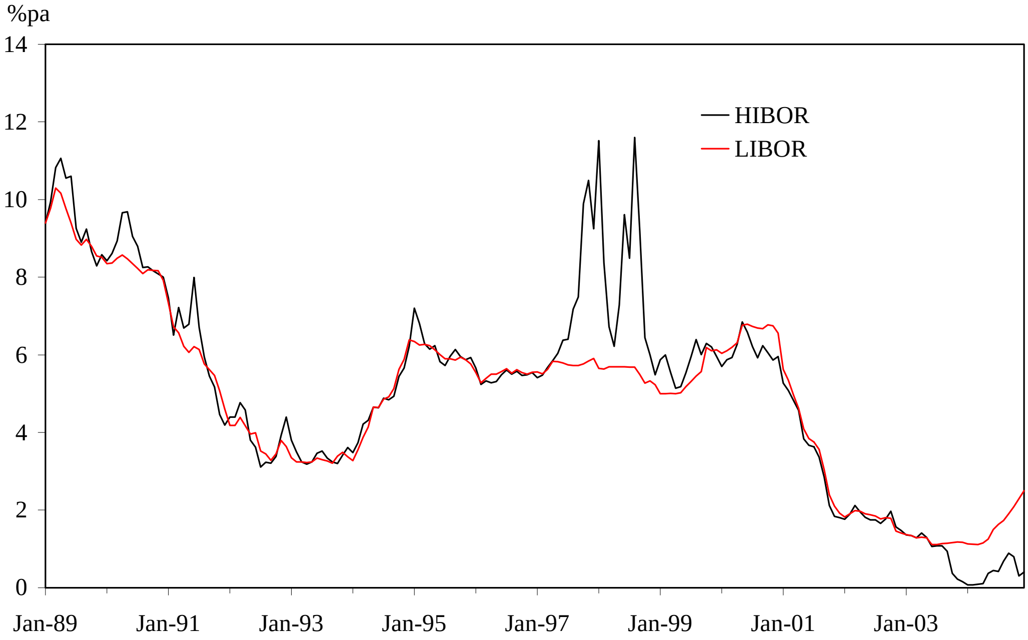
8 Such as in the cases of October and November 1997. BLR was raised twice due to changes in cost of funds, in particular increases in HIBOR, when the US Federal funds rate was unchanged.

9 LIBOR stands for London Interbank Offered Rate, which is the interest rate on US dollar-denominated deposits (also known as the Eurodollars) traded between banks in London. LIBOR is widely used as a proxy for US market interest rates.

Chart 3. Movements of 3-month HIBOR and 3-month LIBOR



Source: CEIC.

To illustrate the potential size of the HIBOR-LIBOR differential, a long-term mean level is established by taking the average of the differential over the past 16 years.[10] This mean level is estimated to be near zero (negative 1.4 bps) with a standard deviation of 56 bps. At 95% confidence level, the upper bound of the risk premium is at +109 bps and the lower bound is at -112 bps. This 95% confidence band provides a simple illustration of the historical dispersion of the risk premium (Chart 4). The analysis shows that if the risk premium shifts to its historical mean level, HIBOR could rise significantly from its current level (by more than 200 bps), even if US market interest rates remain unchanged.

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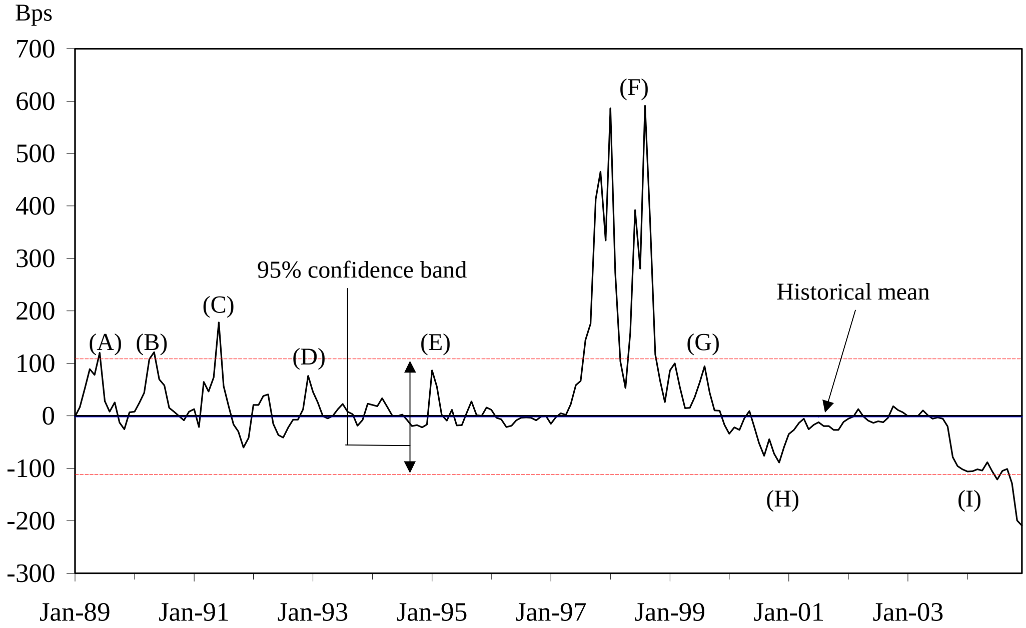
[10] The average is calculated by excluding the risk premium during the Asian financial crisis and the "double-market play" episode.

Chart 4. Risk Premium



Notes: Historical mean and the confidence bound are calculated by excluding observations during the Asian financial crisis and the "double-market play" episode.

Some of the fluctuations of the risk premium over the period appear to have roughly matched the following events:

(A) June 4 event, 1989.
(B) Interest rate hikes by a total of 100 bps in April 1990.
(C) Closure of BCC (HK) in June 1991.
(D) ERM turmoil in the fourth quarter of 1992.
(E) Mexican currency crisis in January 1995.
(F) The Asian financial crisis and the "double-market play" episode between July 1997 and September 1998.
(G) Tension over the Taiwan Strait in 1999.
(H) Strong demand for Hong Kong dollar assets in the second half of 2000, as the US economy began to show signs of slowing down.
(I) Increased inflows of funds from the fourth quarter of 2003 onwards, triggered by US dollar weakness and increased pressures on a renminbi appreciation.

Sources: CEIC and HKMA staff estimates

IV. POTENTIAL REDUCTION IN INTEREST RATE MARGINS[11]

In order to assess the potential impact on interest margins of banks' existing mortgage portfolio of (i) the narrowing of spread during the current tightening phase of US interest rate cycle and (ii) a possible reversal of the risk premium, we make use of estimated error correction models.[12]

In the models, the two sources of influence are examined separately by decomposing the HIBOR as follows:[13]

HIBOR = LIBOR + risk premium

The flow of the two sources of influence is illustrated in Chart 5. While these two influences will have one-to-one effects on changes in HIBOR through the above identity, the transmission of the effect to the BLR, the TDR and the EDR can be estimated by the models. In turn, the impact on the interest rate margin of banks' current mortgage loan portfolio can be assessed by comparing the difference between the response of HIBOR and BLR to these two influences for HIBOR-financed loans, and between the response of TDR (or EDR) and BLR for loans financed by customers' deposits.[14, 15]

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11 In this study, the assessment focuses on the potential reduction in interest rate margins in the future period (i.e. when US interest rates continue to rise or there is a reversal of risk premium). The issue of intertemporal maximisation (of the current period and the future period) is not examined. In addition, it is assumed that, given the highly competitive environment and consumer protection, banks will not be able to unilaterally change the current interest rate structure of fixing mortgage rates in relation to BLR or HIBOR for the existing loan portfolio, or to set BLR significantly different from market BLR rates. They will also refrain from charging different BLRs for new and existing loans.

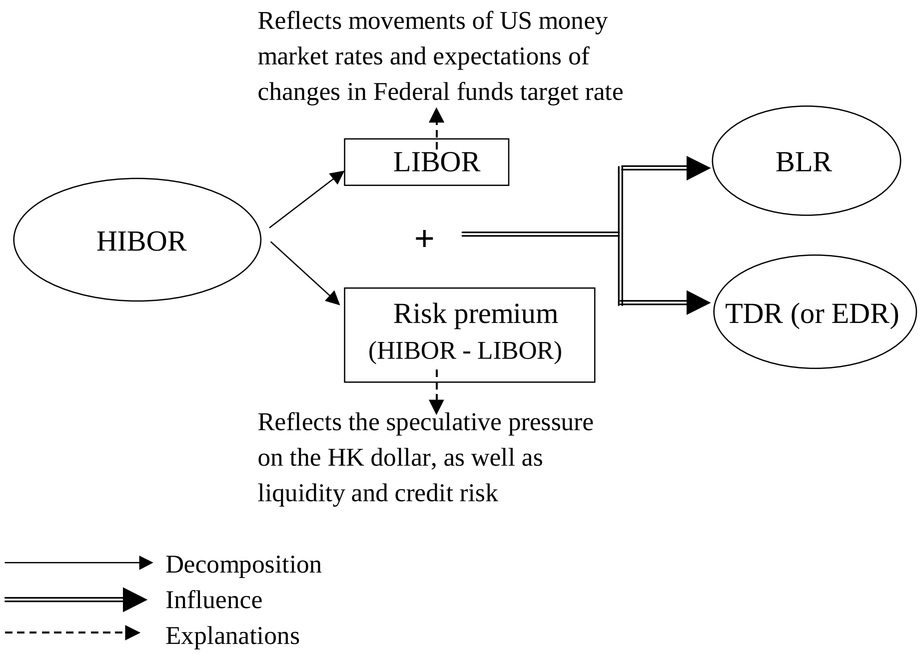
12 See Annex IV for a discussion of the cointegration and error correction model.

13 This follows the analysis of Peng et al. (2003) in which they examine how different sources of change in interbank interest rates impact on the banking sector's profitability, as well as lending and deposit rates.

14 In this study, to simplify the analysis, we classify mortgage loans into three groups: HIBOR- financed loans, time deposits-financed loans, and loans financed by a mix of customers' deposits weighted by their relative shares (the interest cost of which is proxied by EDR). We further assume that the former group of loans is entirely funded by interbank borrowings while the latter two groups by the respective types of customers' deposits.

15 Savings deposit rate is generally adjusted along with the BLR by similar magnitudes. However, as time deposit rates are influenced by the movement of HIBOR, the spread of EDR over BLR varies overtime.

Chart 5. Flow of Influence



4.1 Model Specification and Estimation Results

Three models (A, B and C) are established for the assessment. Model A examines how BLR may move in response to changes in LIBOR (representing changes in US interest rates) and risk premium, while Models B and C capture the relationships between TDR or EDR, respectively, and changes in LIBOR and risk premium. The model specifications are given in Annex V. They are constructed so as to facilitate the identification of long-term co-movements and short-term deviations as well as their interactions.[16]

The models are estimated using data from January 1989 to January 2005. The estimation results are summarised and discussed in Annex V. The main findings are as follows:

(1) A 100 bps increase in LIBOR would result in a 42 bps increase in BLR in the short run, while a 100 bps rise in risk premium would increase BLR by 29 bps. In the long run, a 100 bps rise in HIBOR, arising either from changes in LIBOR or risk premium, would increase BLR by 74 bps.

[16] The short-run effect reflects the response of the dependent variable in the immediate month, while the long-run effect measures average changes in the dependent variable over the study period.

(2) A 100 bps increase in LIBOR would result in a 59 bps increase in TDR (or a 52 bps increase in EDR) in the short run, while a 100 bps rise in risk premium would increase TDR by 61 bps (or by 49 bps in EDR). In the long run, a 100 bps increase in HIBOR (either from changes in LIBOR or in risk premium) would increase TDR by 91 bps and EDR by 81 bps.

(3) The fact that (i) the responses of BLR to HIBOR, LIBOR and risk premium are less than unity (as against the unity response of HIBOR to LIBOR and risk premium); and (ii) the response of TDR and EDR to a rise in LIBOR and risk premium is greater than the response of BLR underlies the risk of a possible reduction in the interest rate margin of banks' existing mortgage loan portfolio. As a result, the BLR – HIBOR, BLR – TDR and BLR – EDR margins will narrow on a rise in LIBOR and a risk premium reversal.[17, 18]

(4) The possible reduction on interest margin would be less severe for deposits-financed loans than HBOR-financed loans, as the former's funding cost would increase less than the latter's, given that TDR and EDR would rise not as much as HIBOR.

4.2 How Interest Margins of Banks May Be Affected

To illustrate how the estimated response arising from a rise of US interest rates and shifts in risk premium may translate into possible effects on banks' interest rate margins, we consider the following three scenarios where the LIBOR and Federal funds target rate increase by 120 bps over a 12-month period[19] and the risk premium (i) stays at the current level (at -197 bps), (ii) moves to its historical mean level (at about -1 bps), and (iii) moves to two-standard deviations above its mean level (at 109 bps).[20]

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[17] As discussed in Section I, the less than unity response of BLR to LIBOR and risk premium reflects the current practice of banks in setting BLR and deposit rates -- BLR normally only adjusts when there is a change in the US Federal funds target rate or when pressures from changes in cost of funds are built up to a certain level. As a result, the transmission of changes in HIBOR (either arising from changes in LIBOR or from risk premium) to BLR is on average less than one.

[18] The greater response of TDR and EDR to changes in LIBOR and risk premium (i.e. to HIBOR) than BLR reflects the fact that, while interest rates on savings deposits have a similar feedback as BLR to changes in LIBOR and risk premium, interest rates on time deposits are more sensitive than BLR to changes in HIBOR.

[19] According to the Federal Funds futures traded at the Chicago Board of Trade, the market has priced in a further rise of interest rates of 120 bps by December 2005.

[20] See Section II for a discussion on risk premium.

The short-term and long-term impacts on the interest margin as well as the cumulative effect over a 12-month period are presented in Table 1.[21] The simulations of the above three scenarios show that:

(1) If we assume an adjustment of 120 bps in LIBOR and the Federal funds target rate, and no change in risk premium, the cumulative effect in a year's time on the spread of BLR over HIBOR is estimated at -74 bps.[22] The cumulative effect by the final month of the simulation period on the spread of BLR over TDR will be –47 bps, while that for BLR over EDR will be milder at -24 bps.[23]

(2) If the risk premium reverts to its historical mean level (from the current level of –197 bps to –1 bps), the combined impact of an increase of 120 bps in US interest rates and the risk premium reversal would be much larger. The spread of BLR over HIBOR would be reduced by a cumulative 168 bps in 12 months time, while the spreads of BLR over TDR, and of BLR over EDR, would narrow by 92 bps and 47 bps respectively.

(3) In a drastic scenario that the risk premium shifts to the upper bound of the two-standard deviation level (from –197 bps to 109 bps), the spread would be under significant pressure.[24] The spreads of BLR over HIBOR, and that of BLR over TDR and over EDR, are expected to narrow by a cumulative 221 bps, 117 bps and 60 bps respectively in 12 months time.

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21 Note that by assuming that the rates of changes in LIBOR and risk premium are gradual and constant throughout the period, the cumulative impact presented in this study refers to the estimated changes between the projected situation in the final month of the forecast period (i.e. January 2006), and the current situation in January 2005 whence BLR is at 5.0%, average HIBOR at 0.70%, average TDR at 0.07%, average EDR at 0.03% and average risk premium at –197 bps.

22 The less than unity transmission is due to the fact that market interest rates tend to price in expected BLR increases ahead of actual BLR adjustments. For a detailed discussion, see Section I.

23 Since the savings rate moves largely in line with the BLR, the reduction on mortgage margin for loans financed entirely by savings deposits would be minimal, while the margin for loans financed purely by demand deposits would in fact widen. For mortgage loans which are funded by customers' deposits which are mainly savings and demand deposits, the impact would be small.

24 The selected high level of two-standard deviations upper bound represents the extreme risk at the high end. There is, nonetheless, a probability of 2.5% that the mean of risk premium may happen to be even higher than this level under the normality assumption.

Table 1. Potential Reduction of Mortgage Spreads
(with an increase of 120 bps in US Interest Rates)

	Scenario of Risk Premium Level		
	(i) Current (-197 bps)	**(ii) Historical Mean (-1 bps)**	**(iii) Upper Bound of Two-standard Deviations Over Mean (109 bps)**
Short-term effect (bps)			
BLR	+51	+119	+158
HIBOR	+120	+355	+488
TDR	+71	+213	+293
EDR	+63	+178	+243
Long-term effect (bps)			
BLR	+89	+263	+361
HIBOR	+120	+355	+488
TDR	+109	+324	+445
EDR	+97	+288	+396
Total cumulative effect in one year (bps)			
BLR	+46	+148	+205
HIBOR	+120	+316	+426
TDR	+93	+240	+322
EDR	+70	+195	+265
Interest Margin (BLR – HIBOR)	***-74***	***-168***	***-221***
Interest Margin (BLR – TDR)	***-47***	***-92***	***-117***
Interest Margin (BLR – EDR)	***-24***	***-47***	***-60***

Notes: For interpretation of the impact, please see footnote 21 and 23.
"-ve" numbers indicate decreases while "+ve" numbers indicate increases.
The short-term effect reflects the response of the dependent variable in the immediate month, while the long-term effect measures average changes in the dependent variable over the study period.

4.3 Impact on Net Interest Margin of Currently Priced Loans and Banks' Overall Mortgage Portfolio

Table 2 presents the simulation results of the impact on net interest margin of currently priced loans and the overall mortgage portfolio. With mortgage loans currently priced at about BLR –3%,[25] HIBOR, TDR and EDR at 0.70%, 0.07% and 0.03% respectively, the gross interest margin for loans financed with interbank funds is about 1.30%, while for loans financed with TDR and EDR, it is 1.63% and 1.67% respectively, including the acquiring cost of deposits. In this study, the gross mortgage margin is derived as the mortgage rate less the funding cost. The funding cost includes the interest cost and the acquiring cost. The interest cost for HIBOR-financed loans is HIBOR, while that for

[25] See footnote 1.

deposits-financed loans is correspondingly TDR or EDR. The acquiring cost is defined as the cost for acquiring deposits. This cost is small for HIBOR-financed loans but quite substantial for deposits-financed loans, since maintaining a retail deposit base requires a bank to operate a large branch network. Specifically, the acquiring cost for HIBOR-financed loans is assumed to be zero, while for deposits-financed loans it is conservatively estimated to be 30 bps, as discussed in details in footnote 26. Taking into account the operating cost for mortgage lending and credit cost, the net interest margins for loans financed by HIBOR, TDR and EDR are estimated at 90 bps, 123 bps and 127 bps respectively.[26, 27]

Under the scenario where US interest rates rise by 120 bps and the risk premium reverses back to its historical mean level, such mortgage loans financed purely with interbank placements (and any new loans made with similar pricing) would become loss-making assets of banks. The simulation results show that net mortgage margin for these loans by the end of the simulation period (January 2006) could fall to –78 bps. The loss would be significant if the risk premium shifts towards its upper bound of historical two-standard deviations range -- net mortgage margin would drop to –131 bps by January 2006. For loans financed by a mix of customers' deposits, the impact would also be tangible, but the net mortgage margin should remain positive. It is noted that banks active in Hong Kong in the residential mortgage business generally have a sizeable customers' deposit base.

For the banks' existing overall mortgage portfolio, the average mortgage pricing is estimated to be roughly BLR minus 2.4%.[28] As there remains in their books a large portion of loans made earlier with less aggressive pricing, banks would have a larger buffer to absorb the possible reduction in the mortgage margin. Taking into account the deposit-acquiring cost, operating cost and credit cost, the net mortgage margin of HIBOR-financed loans would be reduced to negative 18 bps in 12 months time, if US interest rates rise by 120 bps and the risk premium reverses back to its mean level. Under the drastic scenario that the risk premium shifts to the upper bound of two-standard deviations above its historical mean, when the effect filters through, the net mortgage margin would be reduced to negative

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[26] The average acquiring costs of deposits or the average operating costs for all banking activities (such as deposit taking, mortgage lending and other transactions) are assumed to be the same in this paper. They include staff and other operating costs. Specifically, they are derived as the average ratio of operating expenses to the sum of total assets and total liabilities for the banking sector as a whole, and by assuming the same operating cost per dollar of transaction for all banking activities. Based on the annual survey from the Census and Statistics Department and HKMA staff estimates, the average operating cost of banks is around 50 bps which is in line with the operating cost estimated in a research note by Morgan Stanley Dean Witter of November 2000. In this study, for simulation purposes, such cost is assumed to be a conservative 30 bps. However, it should be noted that such cost varies greatly among different banks.

[27] The credit cost is estimated with information provided informally by a few banks. This is lower than the 30 bps estimated in a research note by Morgan Stanley Dean Witter of November 2000, and is in line with the fact that, based on recent performance of the property market and the low level of delinquency rate, the current provisions for mortgage loans should be smaller than in 2000. It should, however, be noted that in the case of a sharp reversal of risk premium, which could result in a significant increase in interest rates, the provision cost could increase materially.

[28] The average pricing is derived by averaging the interest margins for new loans from December 2001 to October 2004 collected by HKMA's Residential Mortgage Survey.

71 bps by January 2006. For deposits-financed loans, their loan portfolios would remain profitable under the three scenarios, although their net mortgage margin would be materially curtailed. The impact would be less significant for EDR-financed loans than for TDR-financed loans.

Table 2. Simulated Impact on Net Interest Margin of Currently Priced Loans and Banks' Overall Mortgage Portfolio
(with an increase of 120 bps in US Interest Rates)

	Scenario of Risk Premium Level		
	(i) Current (-197 bps)	(ii) Historical Mean (-1 bps)	(iii) Upper Bound of Two-standard Deviations over Mean (109 bps)
(A) Impact on net interest margin of currently priced loans			
HIBOR-financed loans (bps)			
Mortgage Pricing	200	200	200
Funding Cost	-70	-70	-70
Current Gross Mortgage Margin	*130*	*130*	*130*
Operating Cost	-30	-30	-30
Credit Cost	-10	-10	-10
Current Net Mortgage Margin	*90*	*90*	*90*
Estimated Reduction of Mortgage Margin	-74	-168	-221
Simulated Net Mortgage Margin After Impact	***16***	***-78***	***-131***
TDR-financed loans (bps)			
Mortgage Pricing – currently priced	200	200	200
Funding Cost	-37	-37	-37
Current Gross Mortgage Margin	*163*	*163*	*163*
Operating Cost	-30	-30	-30
Credit Cost	-10	-10	-10
Current Net Mortgage Margin	*123*	*123*	*123*
Estimated Reduction of Mortgage Margin	-47	-92	-117
Simulated Net Mortgage Margin After Impact	***76***	***31***	***6***
EDR-financed loans (bps)			
Mortgage Pricing	200	200	200
Funding Cost	-33	-33	-33
Current Gross Mortgage Margin	*167*	*167*	*167*
Operating Cost	-30	-30	-30
Credit Cost	-10	-10	-10
Current Net Mortgage Margin	*127*	*127*	*127*
Estimated Reduction of Mortgage Margin	-24	-47	-60
Simulated Net Mortgage Margin After Impact	***103***	***80***	***67***
(B) Impact on net interest margin of banks' overall mortgage portfolio			
HIBOR-financed loans (bps)			
Mortgage Pricing	260	260	260
Current Gross Mortgage Margin	*190*	*190*	*190*
Current Net Mortgage Margin	*150*	*150*	*150*
Estimated Reduction of Mortgage Margin	-74	-168	-221
Simulated Net Mortgage Margin After Impact	***76***	***-18***	***-71***

Table 2 (continued)

TDR-financed loans (bps)			
Mortgage Pricing	260	260	260
Current Gross Mortgage Margin	*223*	*223*	*223*
Current Net Mortgage Margin	*183*	*183*	*183*
Estimated Reduction of Mortgage Margin	-47	-92	-117
Simulated Net Mortgage Margin After Impact	***136***	***91***	***66***
EDR-financed loans (bps)			
Mortgage Pricing	260	260	260
Current Gross Mortgage Margin	*227*	*227*	*227*
Current Net Mortgage Margin	*187*	*187*	*187*
Estimated Reduction of Mortgage Margin	-24	-47	-60
Simulated Net Mortgage Margin After Impact	***163***	***140***	***127***

Notes: The mortgage pricing conservatively estimated in this section includes cash rebates of around 1% of the loan amounts and assumed a full amortisation period of three years. In this section the assessment covers only the first year but it is worth noting that by the fourth year the effective mortgage pricing will become BLR-2.75% when the cash rebates are fully amortised. See Section 4.3 for a discussion of the funding cost which consists of interest cost and acquiring cost, and footnotes 26 and 27 for the operating cost and the credit cost respectively. The same funding cost, operating cost and credit cost are applied to estimations of the net mortgage margin of currently priced loans as well as banks' overall mortgage portfolios. For interpretation of the results, please see footnotes 21 and 23.

Note that the above analysis simulates the cases of entirely HIBOR and deposits-financed loans. How the margin of the mortgage portfolio of individual banks may be affected depends much on their funding compositions and their actual operating and credit costs, with banks more reliant on interbank fundings estimated to be more adversely impacted. Compared to large retail banks which have substantial demand and savings deposits in their customers' deposit base, banks with a larger share of time deposits, which are more HIBOR related, could be more adversely affected.

V. CONCLUSION

With US interest rates in the tightening phase of the interest rate cycle, and given the long repayment period of mortgages, there are risks of a reduction on the interest rate margin for mortgage loans made under the prevailing monetary conditions, in the time ahead and over their mortgage life. Such risks could arise from an expected narrowing of BLR – HIBOR, BLR – TDR and BLR – EDR spreads and a reversal of the risk premium of Hong Kong dollar against the US dollar to a more neutral level.

As suggested by simulation results derived under the assumption of a further rise in US interest rates and different scenarios of risk premium reversal, the mortgage portfolio of banks priced on the currently very low funding cost could face a reduction in their interest rate margin. Under the scenario that the risk premium reverses to its mean level, loans financed purely with interbank placements may become loss-making assets of banks.

It is noted that banks active in Hong Kong in the residential mortgage business generally have a sizeable customers' deposit base. Nevertheless, banks should take into account such interest rate risk in the pricing and management of their mortgage portfolios.[29]

[29] Detailed supervisory guidance on interest rate risk management is set out in the HKMA guidance note on "Interest Rate Risk Management" (IR – 1) of the Supervisory Policy Manual.

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Annex I

Effective Mortgage Rates

A brief survey of selected retail banks on 15 January 2005 shows that they were offering cash rebate ranging from 0.7% to 1.4% of the mortgage amount. Taking into account this cash rebate and assuming a full amortisation period of three years, the effective mortgage rate is conservatively estimated at around BLR –3%. Note that by the fourth year of the loans, when the cash rebates are fully amortised, the effective mortgage pricing will become BLR –2.75%.

On 28 February 2005, the HKMA issued a circular to all authorized institutions (AIs) reminding them of the need to monitor carefully the risks associated with residential mortgage lending including setting out the treatment of cash rebates and interest/repayment holidays within the context of the 70% loan-to-value (LTV) ratio guideline.

The term "cash rebates" applies to lump sum payments, payments by instalments, and interest or repayment holidays offered to borrowers. The circular states that:

- if a cash rebate is in excess of 1% of the loan amount of a residential mortgage, it should be treated as part of the loan amount for calculating the LTV ratio;

- if a cash rebate is not in excess of 1% of the residential mortgage, there is no need for it to be counted as part of the loan amount. However, disbursement of the cash rebate should be made only after completion of the purchase of the property in question; and

- for residential mortgage schemes involving cash rebate subsidy offered by property developers, the lower of the discounted price or the valuation of the property should be used as the basis for calculating the LTV ratio. AIs should ensure that adequate disclosure regarding such schemes has been made to the borrowers in conformity with the spirit and objectives of the Code of Banking Practice.

Annex II

Tests of Lead-lag Relationship between LIBOR and BLR

To examine such a hypothesis that Hong Kong's market rates move ahead of BLR, joint tests of cross-correlations and Granger causality test are conducted. In order to perform the assessment, HIBOR is decomposed into US market interest rates (LIBOR) and the spread of HIBOR over LIBOR, with the latter reflecting the risk premium of the Hong Kong dollar against the US dollar, which is determined by speculative pressures on the currency, as well as liquidity and credit risk. The influence of risk premium is controlled and the tests are conducted on BLR and LIBOR.

As shown in Table A1, the test result of cross-correlations shows that past adjustments of LIBOR has predictive ability for current changes in BLR, while that of Granger causality also accepts that changes in LIBOR Granger cause changes in BLR. These findings confirm that the observed narrowing of spread during the tightening phase of interest rate cycle has been partly due to the lead-lag relationship between HIBOR and BLR in their response to US interest rate adjustments.

Table A1. Tests of Lead-lag Relationship between LIBOR and BLR

Joint test of cross-correlations[1]	
Null hypothesis:	Test statistic
ΔBLR_{t-k} does not predict $\Delta LIBOR_t$	22.60
$\Delta LIBOR_{t-k}$ does not predict ΔBLR_t	73.31*
Pairwise Granger Causality test[2]	
Null hypothesis:	Test statistic
ΔBLR does not Granger cause ΔLIBOR	1.48
ΔLIBOR does not Granger cause ΔBLR	5.69*

Notes:
1. Joint tests with up to 12 lags of cross-correlations are considered. The test statistic follows asymptotically a χ^2 distribution with 12 degrees of freedom.
2. Wald statistics for the joint hypothesis are reported. The test is based on the past 12 lags of observations.

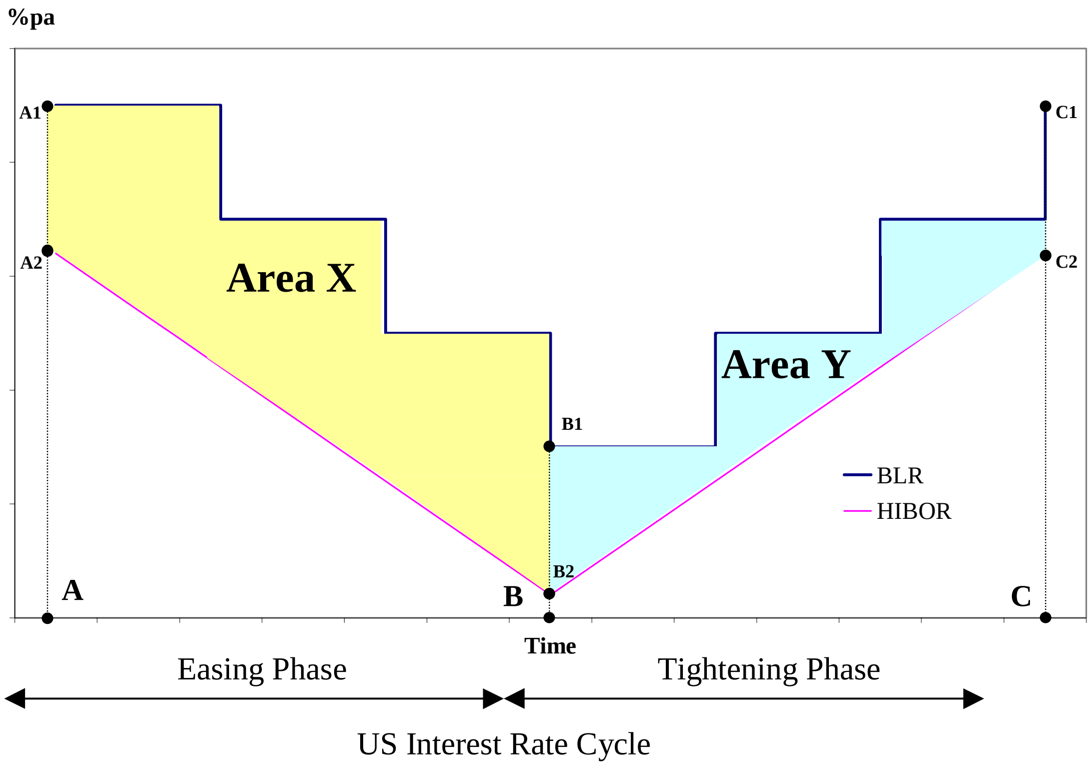
* Denotes significant at the 5% level.

Annex III

Graphical Illustration of the narrowing of interest spread between BLR and HIBOR during the tightening phase of an interest rate cycle

Chart A1 illustrates the narrowing of interest spread between BLR and HIBOR during the tightening phase of an interest rate cycle. During the easing cycle of US interest rates (when interest rates move from point A to point B), the HIBOR falls ahead of BLR and the average interest spread between the two interest rates is represented by Area X. During the up cycle of US interest rates (when interest rates move from point B to point C), the average interest spread is represented by Area Y. Area Y is smaller than Area X.

Chart A1. Illustration of Interest Spread Narrowing



Annex IV

Cointegration and Error Correction Model

Consider a vector of *n* time series, $Y_t = (y_{1t}, y_{2t}, \ldots, y_{nt})^T$, all of which are integrated of order one, such that their first differences (ΔY_t , or $Y_t - Y_{t-1}$) are stationary. If there exists at least one linear combination of these time series such that the residuals exhibit a stationary pattern, they are said to be cointegrated. The error correction mechanism allows short-term deviations from the long-term equilibrium and measures the rate of correction. Thus, the whole model provides a more general form to describe the co-movement of several nonstationary time series. The general representation of the model is as follows:

$$\Delta Y_t = \mu + \alpha\beta Y_{t-1} + \sum_{i=1}^{K} \phi_i \Delta Y_{t-i} + \varepsilon_t \ . \qquad \text{(E1)}$$

E1 is the error correction representation of the evolution of the variables in Y. The term βY_{t-1} captures the long-run relationship between them and α measures the speed with which deviations from long-run equilibrium are eliminated. The lags of ΔY are included to capture the short-run interactions between the variables. A full description of the cointegration and error correction framework can be found in Engle and Granger (1987) and Johnansen (1991). Some recent empirical applications of the model to interest rates can be found in Scholnick (1996) and Scholnick (1999) which focus on bivariate variables of Y_t in the error correction form.

Annex V

Model Specification and Estimation Results

In order to assess the potential impact on the interest margin of banks' existing mortgage portfolio of (i) the narrowing of the spread during the current tightening phase of US interest rate cycle and (ii) a possible reversal of the risk premium, an error correction model is specified.

Three models (A, B and C) are considered. Model A is specified with the BLR as the dependent variable, while Model B is specified with the TDR and Model C with the EDR as the dependent variable respectively. They both have LIBOR and risk premium as independent variables in the short-run and long-run equations. A restriction is imposed on the long-run equations to require the coefficients for the variables LIBOR and risk premium to be the same. This is because the long-run response of local retail interest rates to changes in market rates should be similar regardless of whether such changes are arising from movements in LIBOR or in risk premium.[30] Past *M* lags of the changes in BLR, TDR and EDR are included in the models to control for serial correlations among observations.[31] In addition, dummy variables are introduced to control for the effect of the Asian financial crisis. This model specification can facilitate the identification of short-term deviations and long-term co-movements as well as their interactions.

Specifically, the error correction models for BLR (Model A), TDR (Model B) and EDR (Model C) are as follows:

<u>Model A</u>

$$\Delta BLR_t = \alpha_0 + \alpha_1 R_{t-1}^A + \phi_1 \Delta LIBOR_t + \phi_2 \Delta prem_t + \phi_3 DS_t + \sum_{j=1}^{M} \varphi_j \Delta BLR_{t-j} + e_t \qquad (1)$$

with

$$R_t^A = BLR_t - \beta_1 LIBOR_t - \beta_1 prem_t \qquad (2)$$

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[30] The imposition of such restriction is equivalent to estimating the long-run equation with HIBOR as the explanatory variable; where in Model A, the equation $R_t^A = BLR_t - \beta_1 HIBOR_t$, and $HIBOR = LIBOR + prem$. Similar restriction is imposed for Models B and C.

[31] The number of lags *M* included is chosen according to the Schwarz criterion (SC). Compared with the Akaike information criterion (AIC), SC imposes a greater penalty for the number of estimated model parameters, hence the use of minimum SC for model selection will always result in a chosen model which has a smaller (or at most equal) number of parameters than that chosen under AIC.

Model B

$$\Delta TDR_t = \alpha_0 + \alpha_1 R^B_{t-1} + \phi_1 \Delta LIBOR_t + \phi_2 \Delta prem_t + \phi_3 DS_t + \sum_{k=1}^{M} \varphi_k \Delta TDR_{t-k} + e_t \quad (3)$$

with

$$R^B_t = TDR_t - \beta_2 LIBOR_t - \beta_2 prem_t \quad (4)$$

Model C

$$\Delta EDR_t = \alpha_0 + \alpha_1 R^C_{t-1} + \phi_1 \Delta LIBOR_t + \phi_2 \Delta prem_t + \phi_3 DS_t + \sum_{l=1}^{M} \varphi_l \Delta EDR_{t-l} + e_t \quad (5)$$

with

$$R^C_t = EDR_t - \beta_3 LIBOR_t - \beta_3 prem_t \quad (6)$$

where $prem_t$ is the risk premium at time t, DS_t is a dummy variable controlling for the dramatic behaviour of interest rates during the Asian financial crisis, R^A_t, R^B_t and R^C_t are variables for the long-run equilibrium, and Δ is the difference operator.[32] Monthly data from January 1989 to January 2005, taken from CEIC, are used for the empirical studies. Results of the tests of nonstationarity and cointegration support that the movements of BLR, TDR and EDR have equilibrium relationships with HIBOR (LIBOR + risk premium) in the long run. The test results are summarised in Tables A2 and A3.

Table A2. ADF Unit Root Test Results

Variable	**Level**		**First**
	No Trend	**Trend**	**Difference**
BLR	-1.84	-2.04	-7.03*
TDR	-1.13	-1.75	-10.76*
EDR	-1.11	-1.62	-10.35*
HIBOR	-1.61	-1.98	-4.63*
95% Critical Values	-2.88	-3.43	-2.88

Notes: * denotes significant at the 5% level. The unit root test is conducted with lags of up to 12.

[32] The value of ΔY_t is the difference between Y_t and Y_{t-1}.

Table A3. ADF Unit Root Test on Long-run Equilibrium

Null Hypothesis : Residuals have a unit root	**Level** *No Trend*
Cointegrated Variable	
BLR, HIBOR (LIBOR + prem)	-4.01*
TDR, HIBOR (LIBOR + prem)	-3.94*
EDR, HIBOR (LIBOR + prem)	-4.92*
95% Critical Values	-3.78

Notes: * denotes significant at the 5% level. Critical values are provided in Engle and Yoo (1987)

Estimation results of equations (1) to (6) are summarised in Table A4, and discussed in Section 4.1. All estimated coefficients, except the constant term in (3) and the previous change of BLR in (1), are statistically significant at the 5% level and have an expected sign. The significance of the coefficients for R_{t-1}^{A}, R_{t-1}^{B} and R_{t-1}^{C} implies that the cointegration and error correction models are appropriate to describe BLR, TDR and EDR.[33] Diagnostic tests for all three models, including the Durbin-Watson test and the Ljung-Box test, suggest that they are adequately specified without significant serial correlations.

[33] The magnitude of the estimated coefficients for R_{t-1}^{A}, R_{t-1}^{B} and R_{t-1}^{C} describes the speed of adjustment for the disequilibrium. A larger coefficient would imply a faster adjustment to the equilibrium. The negative sign of the coefficients indicates that when the BLR, TDR or EDR are too high relative to the LIBOR and risk premium, the current BLR, TDR or EDR will be adjusted downward to restore the long-run equilibrium relationship.

Table A4. Estimation Results of Models A, B and C[34]

Variable		Coefficient	t-statistic	p-value
<u>Model A : BLR</u>				
<u>Short run (1)</u>				
Constant		0.47*	4.54	0.00
R^A_{t-1}		-0.11*	-4.75	0.00
$\Delta LIBOR_t$		0.42*	5.67	0.00
$\Delta prem_t$		0.29*	3.34	0.00
ΔBLR_{t-1}		0.18	1.65	0.10
DS_t		0.07*	2.74	0.01
<u>Long run (2)</u>				
LIBOR		0.74*	15.4	0.00
prem		0.74*	15.4	0.00
Adj. R-squared	0.50			
Q(6)	6.89			
Q(12)	11.41			
DW	2.17			

Variable		Coefficient	t-statistic	p-value
<u>Model B : TDR</u>				
<u>Short run (3)</u>				
Constant		-0.06	-1.80	0.07
R^B_{t-1}		-0.09*	-3.30	0.00
$\Delta LIBOR_t$		0.59*	7.14	0.00
$\Delta prem_t$		0.61*	7.29	0.00
ΔTDR_{t-1}		0.14*	2.15	0.03
DS_t		0.43*	8.24	0.00
<u>Long run (4)</u>				
LIBOR		0.91*	14.22	0.00
prem		0.91*	14.22	0.00
Adj. R-squared	0.71			
Q(6)	11.90			
Q(12)	14.88			
DW	2.34			

[34] Models A, B and C are estimated with the restriction that the estimated coefficients for the variables *LIBOR* and *prem* in the long-run equations are the same (see Annex V). Note that, consistently, if no such restriction is imposed, the estimated coefficients for the two variables in the long-run equations are not statistically different from each other.

Table A4 (continued)

Model C : EDR

Short run (5)				
Constant		-0.06*	-2.02	0.04
R^{C}_{t-1}		-0.08*	-3.20	0.00
$\Delta LIBOR_t$		0.52*	7.67	0.00
$\Delta prem_t$		0.49*	7.35	0.00
ΔEDR_{t-1}		0.15*	2.08	0.04
DS_t		0.34*	8.30	0.00
Long run (6)				
LIBOR		0.81*	13.38	0.00
prem		0.81*	13.38	0.00
Adj. R-squared	0.72			
Q(6)	15.77*			
Q(12)	18.07			
DW	2.37			

Notes: * denotes significant at the 5% level. DW indicates the Durbin-Watson test statistic. Q(k) is the Ljung-Box test statistic up to lag k. It asymptotically follows the χ^2 distribution with k degrees of freedom, which is denoted by χ^2(k). The critical values for χ^2(6) and χ^2(12) at the 5% level are 12.59 and 21.03 respectively. The short-run effect reflects the response of the dependent variable in the immediate month, while the long-run effect measures average changes in the dependent variable over the study period.

Given that all estimated coefficients for LIBOR are less than unity in Model A and changes in LIBOR have one-to-one effects on changes in HIBOR, the interest rate margin between BLR and HIBOR will respond asymmetrically to a tightening and a easing of US interest rates (Note that the asymmetry discussed in this paper refers to the difference between the responses of interest rate margin to an increase and a decline in US interest rates and does not refer to the difference in the estimated coefficients). Based on the estimation results, an increase of 100 bps in LIBOR will increase BLR by 42 bps and HIBOR by 100 bps. The difference in the rates of change narrows the spread by 58 bps at the end of the projection period, i.e., the interest rate margin will decrease. On the other hand, when LIBOR decreases by 100 bps, BLR and HIBOR will fall by 42 bps and 100 bps respectively. The change will widen the spread by 58 bps at the end of projection period. Thus, the slower response rate of BLR compared with that of HIBOR will give rise to an asymmetric performance in interest rate margins during the tightening and easing phases of an interest rate cycle.

The asymmetric responses to different phases of an interest rate cycle are also observed in the interest rate margins of BLR–TDR and BLR–EDR. Since all estimated coefficients for LIBOR in Models B and C are larger than those in Model A, the response of BLR to LIBOR will be slower than that of TDR and EDR. Similar to the interest rate margin of BLR-HIBOR, the margins of BLR-TDR and BLR-EDR therefore behave asymmetrically to a easing or a tightening of US interest rates.