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CREDIT DEVELOPMENTS IN HONG KONG: HOW ARE THEY RELATED TO MONETARY CONDITIONS IN MAINLAND CHINA?

Prepared by Man-Keung Tang and Philip Ng*
Research Department

Abstract

This paper studies how monetary conditions in Mainland China affect Hong Kong's credit developments, after controlling for domestic and global factors. Empirical results suggest that unexpectedly higher carrying costs of borrowing and tighter-than-expected quantitative access to credit on the Mainland tend to lead to faster growth in external loan extension and higher loan-to-deposit ratios in Hong Kong. Overall, Mainland shocks are found to have accounted for a significant part of the unexpected fluctuations in these two credit condition measures. Historical decompositions further reveal that the relative importance of Mainland shocks seems to have increased in recent years.

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Authors' E-Mail Addresses:
mktang@hkma.gov.hk; phtng@hkma.gov.hk

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EXECUTIVE SUMMARY:

- *External loans, i.e. the sum of all foreign currency loans and Hong Kong dollar loans for use outside Hong Kong, have become an increasingly important component of our banking system, given their growing size and strong procyclicality.*

- *One major factor driving external loans appears to have been Mainland-related lending, the demand for which could be linked to the Mainland's evolving monetary conditions. Previous HKMA study (He, Leung and Ng, 2007) indeed showed that Mainland factors could affect Hong Kong's credit condition through interbank interest rates.*

- *This paper builds on that research and explores how Mainland factors may affect Hong Kong's credit conditions through direct credit channels, in addition to the money market rates channel as previously studied.*

- *Empirical results show that higher carrying costs of borrowing on the Mainland — reflected by the Mainland's renminbi (RMB) policy rates, US dollar interest rate differential, and expectations of RMB appreciation — tend to lead to faster growth in Hong Kong's external loans and higher loan-to-deposit (LTD) ratios.*

- *Likewise, a tighter quantitative access to credit on the Mainland — as proxied by the reserve requirement policy — appears to generate similar effects. On the other hand, faster loan growth on the Mainland tends to be associated with faster external loan growth and higher LTD ratios in Hong Kong, possibly driven by unobserved credit demand factors.*

- *For the sample period as a whole, Mainland shocks are found to have been as important as global shocks in explaining the unexpected fluctuations in Hong Kong's external loan growth, albeit somewhat less so in accounting for the unexpected fluctuations in the total LTD ratio. Moreover, the relative importance of Mainland shocks seems to have increased in recent years.*

I. INTRODUCTION

External loans, which refer to the sum of all foreign currency loans and those Hong Kong dollar (HKD) loans that are for use outside Hong Kong, have become an increasingly important component of the banking system. Since 2007, the swing of credit cycles in Hong Kong has been amplified by the external loan component. By way of its impact on loan-to-deposit (LTD) ratio, the fluctuations in external loan growth may have important implications for the banking sector's liquidity condition. In fact, fast growth in external loans since 2010 has been accompanied by notable increases in LTD ratios, which exert funding pressures on banks.

One of the major factors driving external loans in recent years appears to have been Mainland-related lending, as suggested by the rapid rise in non-bank Mainland exposure of Hong Kong banks. Some observers attribute the strong credit demand associated with businesses on the Mainland partly to its evolving monetary conditions, such as shifts in the credit policy stance and in market expectations about the RMB exchange rate.

An earlier HKMA analysis (He, Leung and Ng, 2007) has already highlighted that Mainland factors could indeed affect Hong Kong's credit condition through interbank interest rates (HIBORs). This result obtained in spite of our Linked Exchange Rate system (LERS), which by design tends to bind the movement in HIBORs with that in their US dollar (USD) counterparts.

In view of the credit developments in recent years, this paper builds on that earlier research and explores how Mainland factors may affect Hong Kong's credit condition through *direct credit channels*, besides solely through the money market rates as studied previously. A particular goal is to help shed light on the conjecture that a tighter (easier) monetary condition on the Mainland might divert more borrowing activities associated with Mainland businesses to (away from) Hong Kong. Two observations motivate this different, though complementary, focus to that employed in the earlier study.

- The impact of Mainland shocks on HIBORs as presented in the earlier study seems likely to be driven by indirect factors, including sentiment — for example, an easing in the Mainland's monetary conditions was found to lead to a *rise* in HIBORs, which was understood to possibly reflect an increase in Hong Kong investors' optimism about the Mainland outlook and an associated rise in their demand for HKD loans. However, given the rapid development of Mainland-related business in the Hong Kong banking sector over the past few years, it is

conceivable that Mainland factors could also directly affect loan demand and LTD ratios in Hong Kong.

- LERS necessarily confines any effects of Mainland shocks on HIBORs to be visible only at the margin, as the short-term interest cost of the HKD is principally determined by that of the USD.[1] However, the magnitude of potential effects of Mainland factors on quantity variables, such as loan volume, could be more significant and may have greater practical relevance.

The paper is organised as follows. Section II highlights some recent developments in loan growth and LTD ratios in Hong Kong, and how they might be in part associated with the increases in Mainland-related lending. Section III examines some possible determinants of Mainland borrowing in Hong Kong. Section IV presents econometric evidences obtained from a vector auto-regression (VAR) model and assesses the importance of the effect of monetary conditions in Mainland China on credit growth and liquidity conditions of Hong Kong's banking sector. The final section provides some concluding remarks.

II. Recent Developments in Loans and Loan-to-deposit Ratios in Hong Kong

Total loans and advances in Hong Kong have been rising at a notable pace since 2007, except for the retreat during the 2008/09 global financial crisis (Table 1). Total loans grew by 20% in 2007 and by an annualised rate of 20.9% in the first three quarters of 2008. The intensification of the US subprime crisis in September 2008 sent shock waves through the global economy and financial system, resulting in a sharp fall in credit growth during 2008 Q4 and 2009. Total loan growth, however, rebounded swiftly in 2010, although the pace has moderated in recent months.

[1] Longer-term, retail interest rates, including commercial bank deposit and lending rates, however, could differ to various degrees from their USD counterparts according to the domestic liquidity situation, demand for loans, intensity in bank competition, etc. (see, for example, Wong and Wong, 2011).

Table 1: Growth in loans and GDP

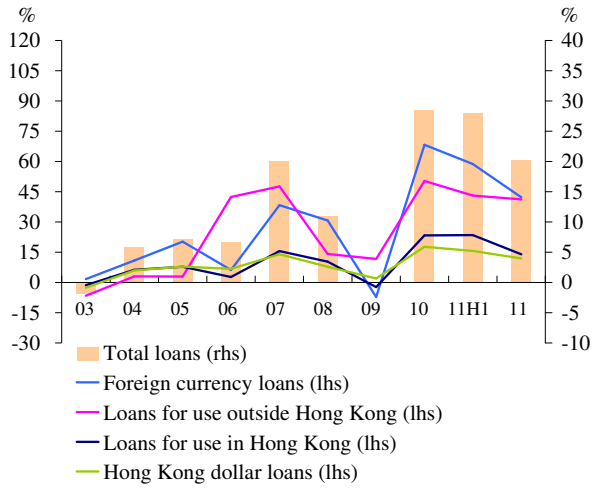
Year	Total loans (%)	Nominal GDP (%)
03	-2.0	-3.3
04	5.9	4.6
05	7.2	7.0
06	6.7	6.7
07	20.0	9.5
08 (Jan - Sep)*	20.9	6.5
08	10.9	3.8
09	0.1	-3.2
10	28.6	7.3
11 (Jan - Jun)*	27.9	9.8
11	20.2	8.7

* Annualised year-to-date growth rate for loans and year-on-year growth rates for GDP.
Sources: Census and Statistics Department, and the HKMA.

Domestic economic activity, however, cannot fully explain the fast credit expansion in recent years as nominal GDP growth and total loan growth have visibly diverged after 2006 (Table 1). While growth in total loans was roughly in line with that in nominal GDP during 2003 – 2006, total loan growth reached more than 20% year on year in many months during the subsequent economic booms, much faster than the single-digit growth in GDP. In addition, HKD lending and loans for use in Hong Kong[2] have grown much more slowly than foreign currency lending and loans for use outside Hong Kong (Chart 1). As a result, the proportion of the former group of loans in total loans has generally been declining since 2006 (Chart 2).

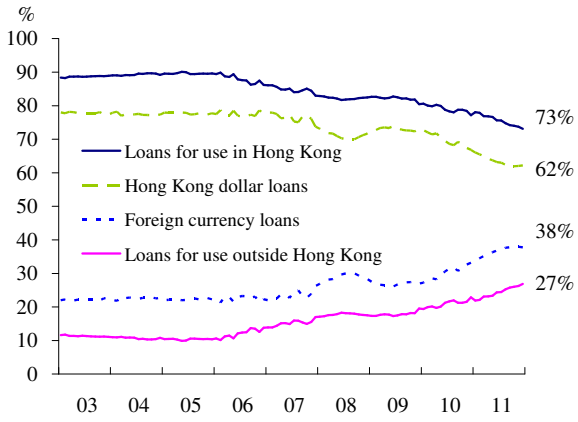
[2] Loans for use in Hong Kong include trade finance.

Chart 1: Loan growth



Source: HKMA.

Chart 2: Shares in total loans



Source: HKMA.

Given its growing size and large volatility, the external loan component[3] has become a main driver of the recent credit cycles in Hong Kong. Changes in this segment of loans, which may not be closely tied to the domestic economic activity, are likely to be significantly influenced by external factors[4] and appear to vary considerably over time. As shown in Chart 3, the growth rates of domestic loans[5] and of external loans have differed quite substantially, especially after 2007. In particular, fluctuations in external loans seem to have amplified the procyclicality of the total credit extension by Hong Kong banks: apart from pushing up total loan growth during the boom periods in the first three quarters of 2008 and in 2010 and 2011, external loans also compounded the contraction in total loans during 2009.

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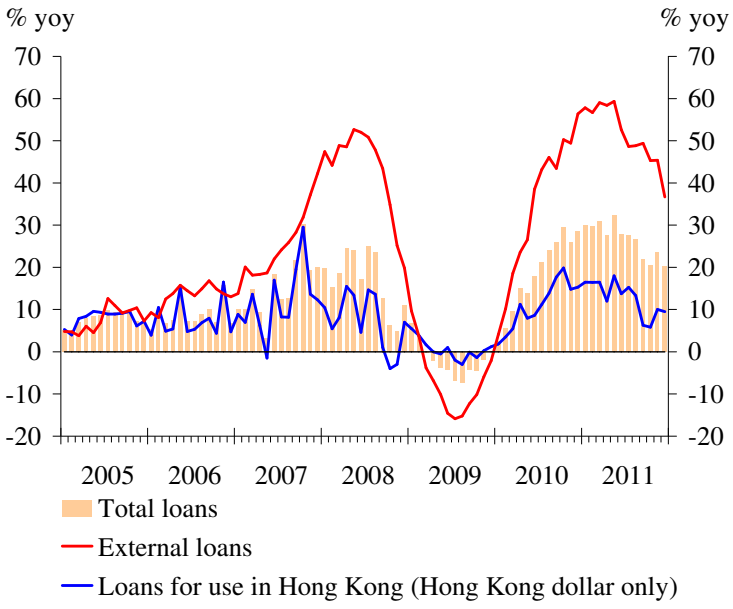
[3] For the purpose of this paper, external loans refer to the sum of all foreign currency loans and those HKD loans that are for use outside Hong Kong.

[4] In general, stronger loan demand can reflect a number of factors including faster growth in external trade and output, lower interest rates (or easier monetary conditions) and favourable exchange rate movements. Given that trade financing loans (foreign currency only) represent around 13% of external loans, faster growth in international output and trade, perhaps driven by the advanced economies like the US, the euro zone and Japan (G3), is expected to increase external loan extension in Hong Kong. Besides, USD and HKD interest rates and expectations of the currencies' future movements can also affect loan demand. For example, a low USD or HKD interest rate, and/or expectations of a weaker USD or HKD exchange rate, could encourage more carry trade-type borrowing and result in higher external loan growth in Hong Kong.

[5] Proxied by HKD loans for use in Hong Kong.

Chart 3: Growth in domestic loans and external loans

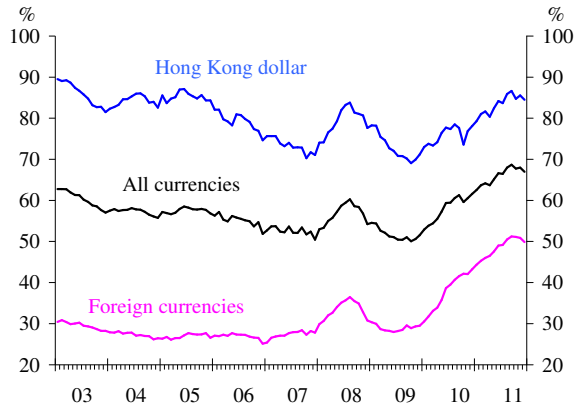


Source: HKMA.

The strong growth in external loans (as well as total credit) since 2008 has been accompanied by notable increases in LTD ratios, which in turn exert some funding pressures on banks. The all-currency LTD ratio has risen markedly by more than 15 percentage points during the period (Chart 4), to the highest level in September 2011. In part reflecting the rise in LTD ratios, Hong Kong banks have raised their effective mortgage interest rates for newly approved loans by around 130 basis points in the first ten months of 2011, despite stable Best Lending Rates and HIBORs.[6] Some banks were also reported to have been offering new customers particularly favourable deposit rates in a stepped-up competition for deposits.

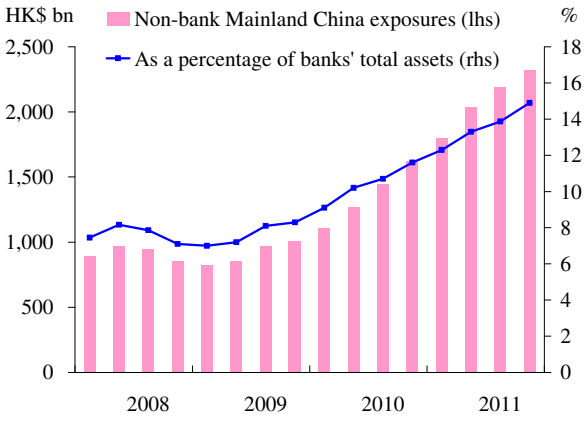
[6] Despite moderating LTD ratios, mortgage interest rates were seen to have shown signs of easing in recent months.

Chart 4: Loan-to-deposit ratios



Source: HKMA.

Chart 5: Non-bank Mainland China exposure



Source: HKMA.

One major factor behind the strong external loan growth during 2008 Q1 – Q3 and 2010 – 2011 appears to have been Mainland-related lending, as suggested by banking data and market information. While no information on the destination of loan use is available, the rises in non-bank Mainland exposure[7] of Hong Kong banks coincided with the fast growth in external loans in 2008 Q1 – Q3, 2010 and 2011 (Chart 5). It is reported that, out of the HK$940 billion increase in total loans extended by Hong Kong banks in 2010, Mainland-related loans accounted for about HK$440 billion (mostly in US dollars).[8]

The secular increase in banks' Mainland exposure appears to have been driven by structural factors, notably the growing integration of commercial activities between the Mainland and Hong Kong. However, relevant from the credit-cycle point of view, what may drive the short-term changes in banks' Mainland-related lending? The next section lays out some of the plausible factors.

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[7] Note that non-bank Mainland China exposures comprise on-balance sheet exposures and off-balance sheet exposures. On-balance sheet exposures include loans to non-banks on the Mainland and loans to Hong Kong non-banks for use on the Mainland, whereas off-balance sheet exposures include positive market value of derivative contracts, guarantees extended and credit commitments.

[8] See the HKMA banking circular issued on 11 April 2011.

III. POSSIBLE DETERMINANTS OF MAINLAND-RELATED CREDIT DEMAND

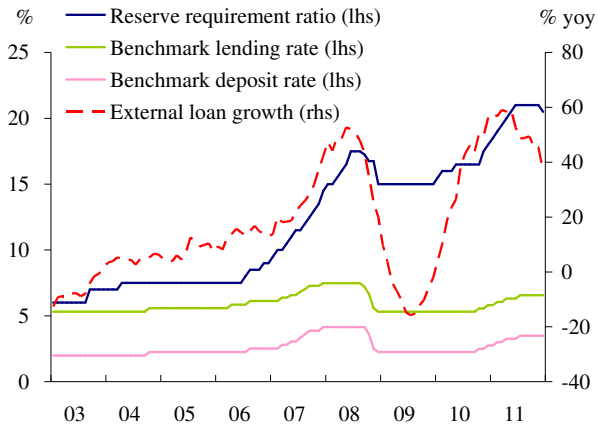
Monetary conditions and real economic activity on the Mainland could impact not only on the overall credit needs to finance Mainland-related businesses, but also to some extent on the borrowers' choice of markets in which to satisfy those needs.

Monetary conditions on the Mainland

Both price and quantity indicators can be used for gauging Mainland's monetary conditions[9] and their possible effects are discussed below.

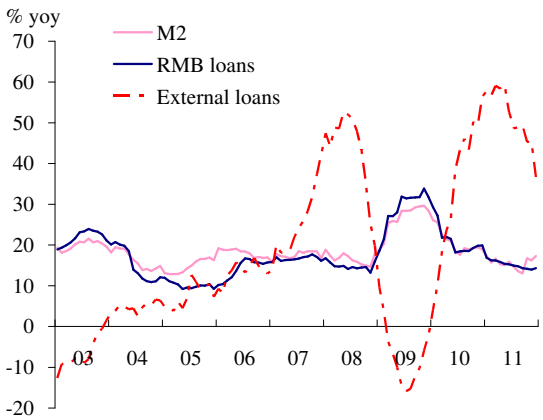
RMB policy interest rates. The policy rates on the Mainland, i.e. the benchmark deposit and lending interest rates, appear to have generally moved in tandem with cyclical economic developments (Chart 6). Higher policy rates translate into costlier borrowing terms on the Mainland, which may induce entities engaged in Mainland businesses to conduct more of their borrowing activities elsewhere, including in Hong Kong.

Chart 6: External loans in Hong Kong and policy interest rates and reserve requirement ratio on the Mainland



Sources: CEIC and HKMA.

Chart 7: External loans in Hong Kong and money supply and loans on the Mainland



Sources: CEIC and HKMA.

The reserve requirement ratio (RRR). As an important quantitative policy tool in Mainland China (Chart 6), a higher RRR could limit bank capacity to make loans on the Mainland, hence possibly diverting some credit demands to banks in Hong Kong.

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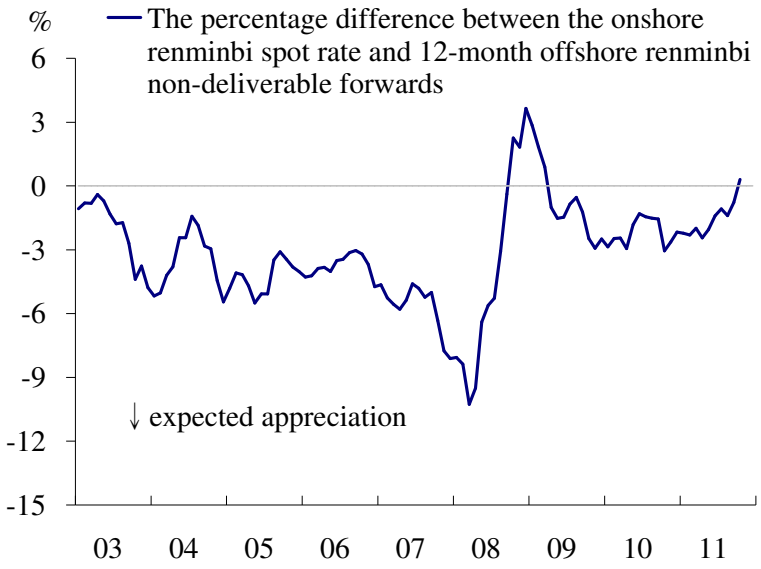
[9] See discussion on "Box 1 How tight are monetary conditions in Mainland China?" in HKMA's Half-yearly Monetary and Financial Stability Report, September 2011, pp. 24 - 29.

Loan growth on the Mainland. The relationship between this variable and Hong Kong's external loan growth could be ambiguous (Chart 7), depending on whether it is credit supply or credit demand that is the dominant factor. On the one hand, a slower loan or money supply growth on the Mainland could reflect a tightening in bank credit policy by the Central Government, which might lead more entities engaged in Mainland businesses to seek funding outside the Mainland's banking system. On the other hand, headline loan growth on the Mainland may carry unobserved information about the underlying credit demand: for example, slower loan growth on the Mainland may in fact be driven by weaker credit demand associated with Mainland businesses, which could also lead to slower external loan growth in Hong Kong.

Expectations of the RMB exchange rate. Besides interest rates, the carrying cost of a RMB-denominated loan is determined also by the expectations of the future RMB exchange rate, which are proxied by the offshore RMB non-deliverable forwards (NDF) (Chart 8).[10] A greater RMB appreciation expectation, for instance, could increase the overall cost of borrowing in RMB, and thus possibly encourage borrowing in other currencies, including the HKD and USD.

Chart 8: Expected RMB appreciation

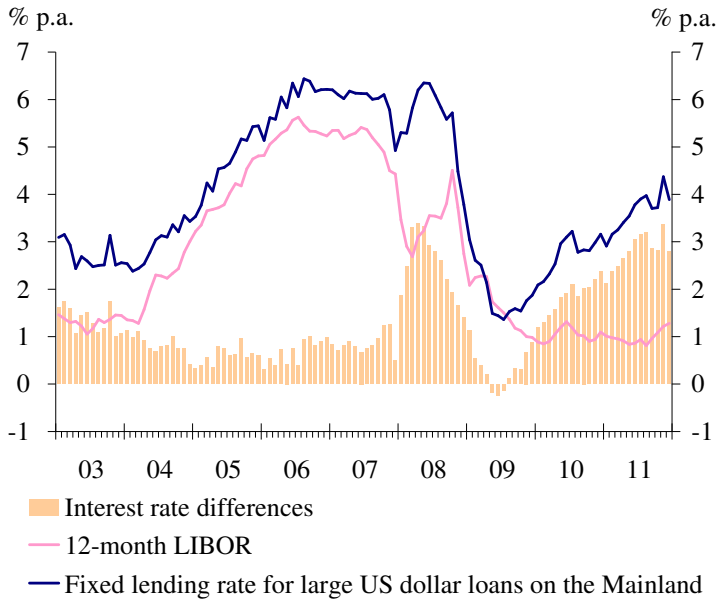


Sources: Bloomberg and authors' estimates.

[10] The reference exchange rate for the offshore NDF is the onshore renminbi-USD exchange rate (CNY). With the offshore spot renminbi (CNH) market continuing to develop and generally tracking tightly the CNY, some suggest that the offshore NDF might have recently become less of a close proxy for the market's expectations on the CNY in light of the increased scope for interest rate arbitrage through the CNH spot market. However, given that our sample period begins as early as 2003 and that even the recent trend of the NDF largely conforms to the apparent direction of market's CNY expectations, the NDF seems to remain a reasonable proxy in our analysis.

USD interest rate differential between Mainland China and Hong Kong. Given the capital account restrictions on the Mainland, USD interest rates on the Mainland and in the international markets (including Hong Kong) can differ significantly, depending on the USD supply and demand conditions on the Mainland (Chart 9).[11] An increase in USD interest rates on the Mainland vis-à-vis in Hong Kong, for example, might encourage entities engaged in Mainland businesses to conduct more of their USD borrowing activities in Hong Kong rather than on the Mainland, thus potentially driving up Hong Kong's external loans. In a simple analysis (not reported here), the USD interest rate differential appears to be partly driven by the expectations of the RMB exchange rate. But other factors, including the Mainland policy rates, B-share stock market performance, and inflows into the onshore RMB, are also found to impact the USD interest rate differential to varying degrees.[12]

Chart 9: US dollar lending interest rates in Mainland China and 12-month LIBOR



Note: Mainland lending rates in July, August and October - December 2008 are interpolated because of missing data.

Sources: WIND and authors' estimates.

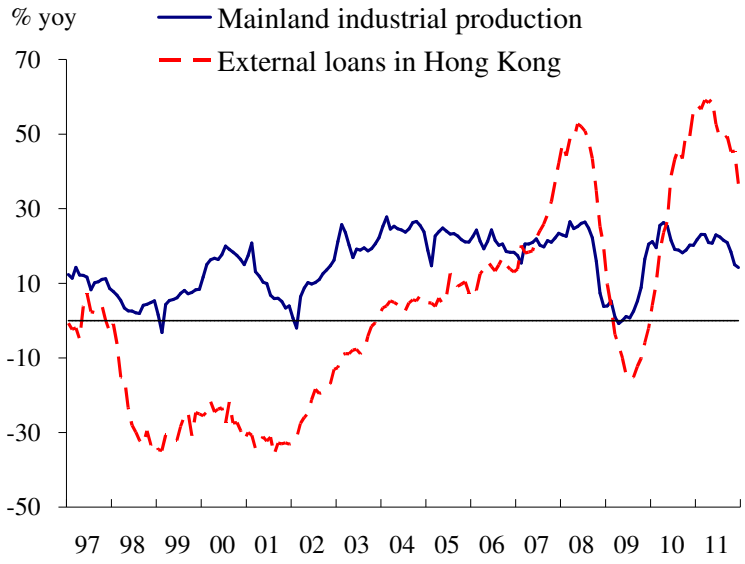
[11] In Mainland China, USD lending interest rates are largely market-driven.

[12] Specifically, the analysis features a simple vector autoregressive model, with six variables ordered in the following sequence: USD LIBOR, a composite measure of Mainland policy rates, B-share stock market index, renminbi appreciation expectations (measured by the offshore NDF), inflows to the onshore renminbi (proxied by the People's Bank of China's foreign exchange purchases less external trade surplus and inward foreign direct investment in Mainland China) and the USD interest rate on the Mainland. Developments that likely decrease USD fund supply or increase USD loan demand in the Mainland banking system tend to result in a rise in the USD interest rates on the Mainland.

Real activity on the Mainland

Output on the Mainland. Hong Kong has been an important centre providing trade finance and syndicated loans in support of economic activity in Mainland China, particularly at its early stage of economic development. Theoretically, faster economic growth on the Mainland tends to stimulate demand for loans by entities engaged in Mainland businesses, including from banks in Hong Kong; on the other hand, higher-than-expected output growth on the Mainland could signal a build-up of overheating pressure and lead to a slowdown in credit demand in anticipation of a tightening in macroeconomic policy. While year-on-year growth in Mainland's industrial production generally appears to have borne a positive correlation with growth in external loans in Hong Kong over the past 15 years (Chart 10), their causal relationship in a multivariate setting will be tested in the following exercise.

Chart 10: Growth in Mainland industrial production and external loans in Hong Kong



Sources: CEIC and HKMA.

IV. Statistical Analysis of External Loans and Loan-to-deposit Ratios Using a Vector Auto-regression (VAR) Model

In this section, **we construct an 11-variable VAR model to assess the dynamic responses of external loans and the total LTD ratio to global and Mainland shocks**. Among the 11 variables in the VAR, three of them are global variables, another six are Mainland variables, and the remaining two are Hong Kong variables, with the last one being our variable of interest (external loan

growth or the LTD ratio). Table 2 lists the VAR variables and recaps the possible theoretical impacts they may exert on external loans or the LTD ratio.[13] The sample period in our benchmark model is between early 2003 and September 2011, chosen mainly because of data availability while retaining sufficient degrees of freedom. Through the estimated VAR, plausible shocks can be identified from the estimated statistical residuals. Details on the identification and estimation of the VAR system are described in Annex A.

Table 2: Variables in the VAR model

	Economic variables	Theoretical effect of a positive shock on year-on-year growth in external loans (or total LTD ratio)
Global or US	G3 industrial production (year-on-year growth)	Tends to be positive
	12-month USD LIBOR	Tends to be negative
	US dollar nominal effective exchange rate index	Tends to be negative
Mainland China	Mainland industrial production, i.e. value added of industry (year-on-year growth)	Ambiguous
	Mainland RRR	Tends to be positive
	Mainland policy interest rate (a weighted average of benchmark one-year nominal lending and deposit interest rates) (a)	Tends to be positive
	Mainland RMB loans (year-on-year growth)	Ambiguous
	The expected rate of appreciation of the renminbi against the US dollar (b)	Tends to be positive (c)
	Spread of US dollar lending rate on the Mainland over the 12-month USD LIBOR	Tends to be positive
Hong Kong	Hong Kong total merchandise trade value (year-on-year growth)	Tends to be positive
	External loans (year-on-year growth) or total LTD ratio	Positive

Notes:

(a) The weight is equal to loans/(deposits + loans) for the lending rate and is similarly defined for the deposit rate.

(b) The percentage difference between the onshore RMB/USD exchange rate and the non-deliverable forwards (in reference to the onshore RMB) on the offshore market. A negative number implies an expected appreciation of RMB against the USD.

(c) In other words, the larger the expected appreciation, the faster the external loan growth is likely to be in Hong Kong.

[13] For the global variables, see He, Leung and Ng (2007) for discussions on how they may theoretically affect Hong Kong's monetary conditions. For the Hong Kong variable of total merchandise trade value, it should have a positive relationship with external loan growth and LTD ratios, as trade finance is an important part of external loans.

Dynamic effects of global and Mainland shocks on external loans and the loan-to-deposit ratio

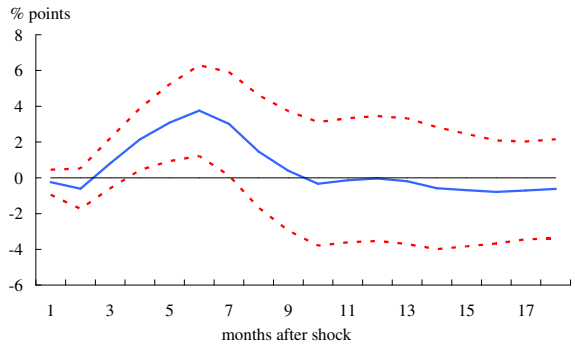
We use the VAR model to trace the response of external loan growth or the total LTD ratio to an unexpected increase in the current value of a global or Mainland variable, assuming that this "shock" returns to zero in subsequent periods and no further shocks occur for all other variables. In essence, the analysis establishes the dynamic effects of various shocks on our variable of interest.

External loan growth

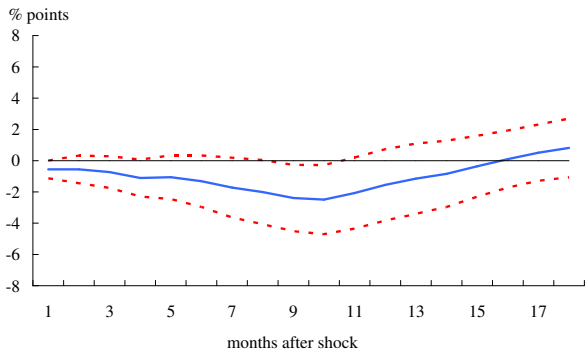
- **Global shocks**. Estimation results show that faster-than-expected growth in G3 output leads to a positive and hump-shaped response of external loan growth in the first 10 months, while a greater-than-expected appreciation of the USD has a negative impact on external loan growth (Chart 11). The impact of a USD LIBOR shock is not significantly different from zero (not shown here).

Chart 11: Response of external loan growth to global shocks

Shock: Year-on-year growth in G3 industrial production increases by one percentage point



Shock: USD nominal effective exchange rate index increases by one unit (or roughly one percentage point)



Note: The response functions (solid lines) and the standard-error bands (dashed lines) are measured in percentage points. The sample period is from June 2003 to September 2011.

- **Mainland shocks**. The responses of external loan growth to positive shocks to the Mainland variables are broadly as conjectured and show rich dynamics (Chart 12).

  - The impact of stronger-than-expected growth in Mainland industrial production is generally positive but not significantly different from zero, possibly due to offsetting economic forces at work, as discussed in section III.

- The effect of a 25-basis-point policy interest rate shock on external loan growth is positive and hump-shaped, raising external loan growth by around 5 percentage points after a year.

- The impact of a 25-basis-point RRR shock on external loan growth is positive and hump-shaped, with external loan growth rising by around 2.5 percentage points after seven months.

- The effect of a one-percentage-point faster-than-expected growth in Mainland loans is positive and hump-shaped, raising external loan growth by around 1.5 percentage points after half a year. The positive relationship may be driven by unobserved credit demand factors — a higher credit demand from the Mainland may simultaneously push up loan extension on the Mainland and external loans in Hong Kong.

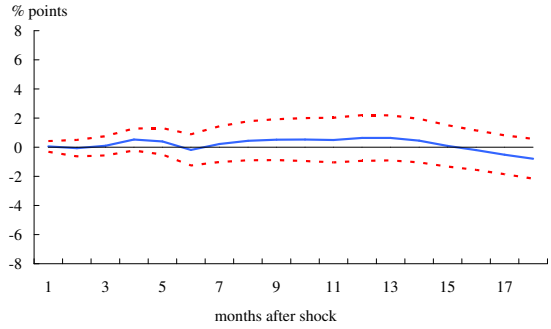
- The response of external loans to stronger expected appreciation of RMB[14] is instantaneous and positive but returns to zero after several months. In particular, a one-percentage-point increase in the expected rate of appreciation leads to a one-percentage-point rise in external loan growth in the first month.

- A 50-basis-point larger-than-expected difference between USD lending rate on the Mainland and LIBOR leads to a positive and hump-shaped response of external loan growth in the first five months, raising external loan growth by around 1.3 percentage points after three months.

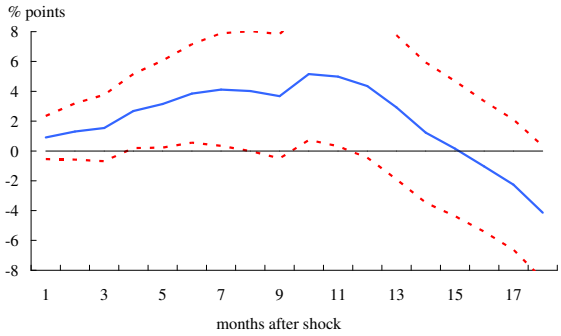
[14] The convention of the variable in the VAR is such that a positive shock implies an expectation of smaller renminbi appreciation or an expectation of larger renminbi depreciation.

Chart 12: Response of external loan growth to Mainland shocks

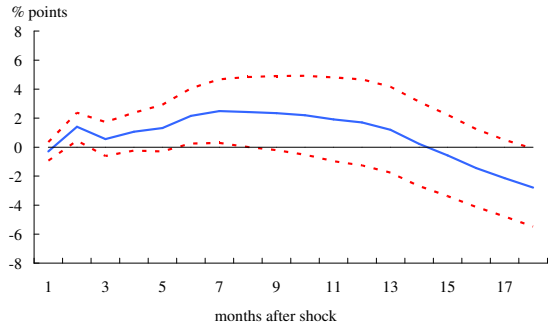
Shock: Year-on-year growth in industrial production increases by one percentage point



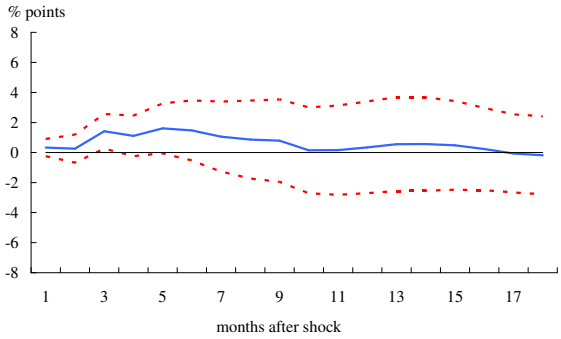
Shock: Policy interest rate increases by 25 basis points



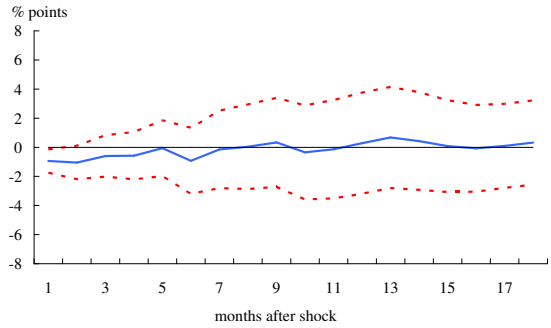
Shock: RRR increases by 25 basis points



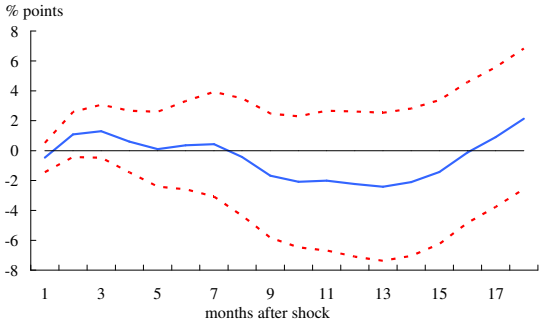
Shock: Year-on-year growth in RMB loans increases by one percentage point



Shock: The expected rate of the appreciation of the RMB decreases by one percentage point



Shock: USD lending rate spread over LIBOR increases by 50 basis points



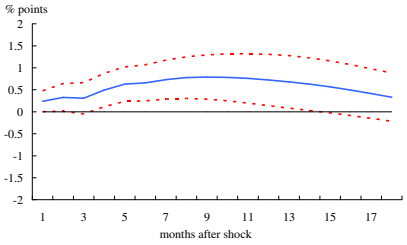
Note: The response functions (solid lines) and the standard-error bands (dashed lines) are measured in percentage points. The sample period is between June 2003 and September 2011.

Total loan-to-deposit ratio

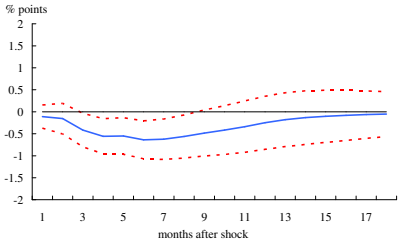
- **Global and Mainland shocks**. The directional responses of the LTD ratio to different global and Mainland shocks are, as expected, similar to those of external loan growth (Charts 13 and 14).[15] However, in contrast to the insignificant effect of a USD LIBOR shock on external loan growth, the statistical exercise shows that a 25-basis-point USD LIBOR shock lowers the LTD ratio by 0.6 percentage points in the first six months and the impact is statistically significant. While the response of external loan growth to stronger expected appreciation of RMB is instantaneous, the response of the LTD ratio is more drawn-out, with maximal impact after seven months. In addition, relative to the response of external loan growth, the response of the LTD ratio to the spread of USD lending rates on the Mainland over LIBOR is more pronounced: the response of the LTD ratio is instantaneous and positive, with a 50-basis-point shock to the spread raising the LTD ratio by around 0.7 percentage points in the first month.

Chart 13: Response of the total loan-to-deposit ratio to global shocks

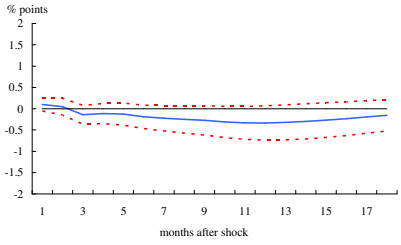
Shock: Year-on-year growth in G3 industrial production increases by one percentage point



Shock: USD interbank interest rate increases by 25 basis points



Shock: USD nominal effective exchange rate index increases by one unit (or roughly one percentage point)

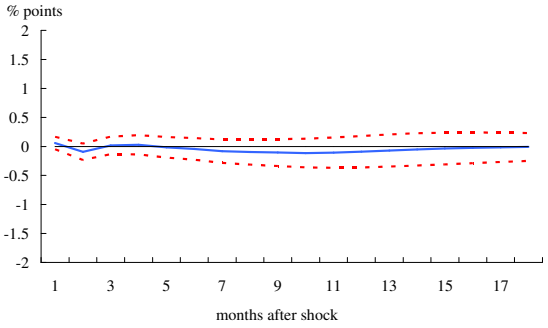


Note: The response functions (solid lines) and the standard error bands (dashed lines) are measured in percentage points. The sample period is from April 2003 to September 2011.

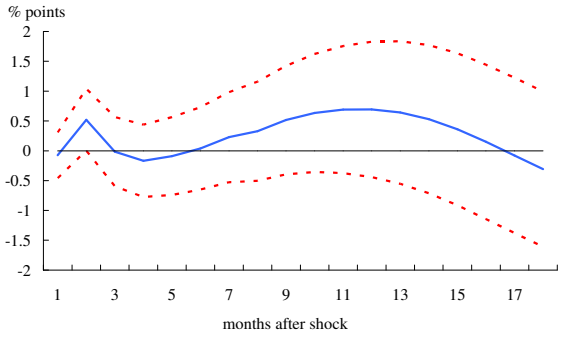
[15] To the extent that most of the external loans are not ultimately used in Hong Kong, the funds may flow back to the Hong Kong banking system from elsewhere in the form of non-deposits. As such, greater external loan growth is likely to imply higher LTD ratios.

Chart 14: Response of the total loan-to-deposit ratio to Mainland shocks

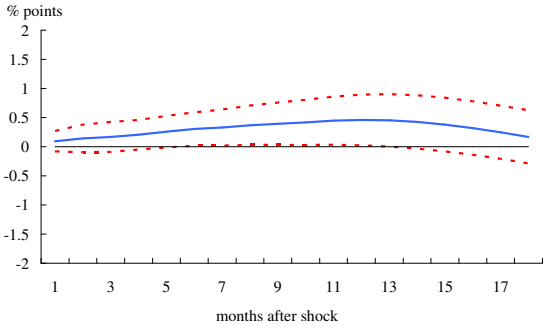
Shock: Year-on-year growth in industrial production increases by one percentage point



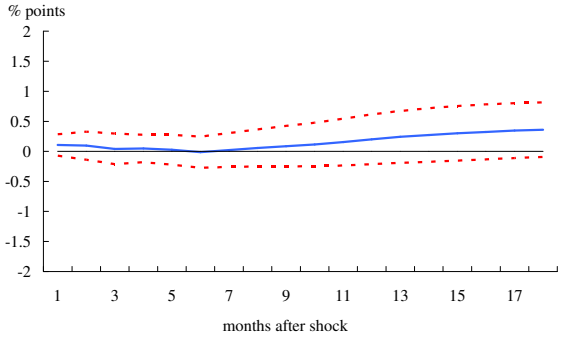
Shock: Policy interest rate increases by 25 basis points



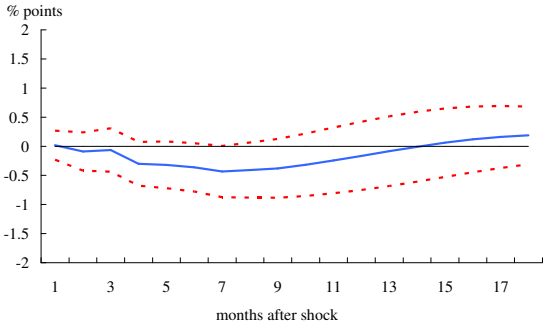
Shock: RRR increases by 25 basis points



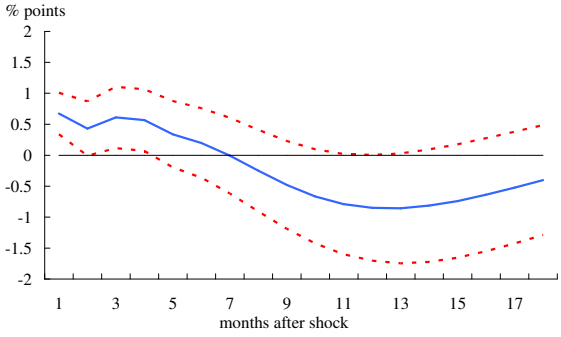
Shock: Year-on-year growth in RMB loans increases by one percentage point



Shock: The expected rate of the appreciation of the RMB decreases by one percentage point



Shock: USD lending rate spread over LIBOR increases by 50 basis points



Note: The response functions (solid lines) and the standard-error bands (dashed lines) are measured in percentage points. The sample period is from April 2003 to September 2011.

Our model's key quantitative estimates on the effects of the Mainland monetary conditions are summarised in Table 3 for ease of reference.

It needs to be noted that in interpreting the results, however, there are two main caveats. First, given that the sample period on which the estimation is based is relatively short and is peppered with many volatile and unusual global events, it might not be representative of a normal time period. As such, the quantitative estimates are best regarded as indicative rather than

definitive in nature. Secondly, with Hong Kong banks' exposures to the Mainland having increased so rapidly in recent years, the true impact of Mainland shocks on Hong Kong's credit development could be understated by the exercise, which measures the average effect over the whole sample period.

Table 3: Indicative quantitative impact of Mainland monetary conditions on credit developments in Hong Kong

	Shocks (unexpected movements)	Estimated effects on: Year-on-year growth in external loans	Estimated effects on: Total loan-to-deposit ratio
Carrying cost of borrowing	RMB policy interest rate ↑ 25 bps	↑ 5 ppts after 1 year	↑ 0.5 ppts after 2 months
	Expected rate of RMB appreciation ↑ 1 ppt	↑ 1 ppt after 1 month	↑ 0.5 ppts after 7 months
	Mainland's US dollar interest rate spread over LIBOR ↑ 50 bps	↑ 1.3 ppts after 3 months	↑ 0.7 ppts after 1 month
Quantitative credit access	RRR ↑ 25 bps	↑ 2.5 ppts after 7 months	↑ 0.5 ppts after 1 year

Note: "ppt(s)" and "bps" refer to "percentage point(s)" and "basis points" respectively.

How big is the role of Mainland shocks in driving Hong Kong's credit developments?

The importance of different shocks in causing the unexpected changes in external loans or the total LTD ratio can be analysed using the statistical tool of (forecast error) variance decomposition. This method allows us to calculate the percentage of the variance of the error made in forecasting the variable of interest due to unexpected changes (shocks) in the global and Mainland variables at different time horizons.

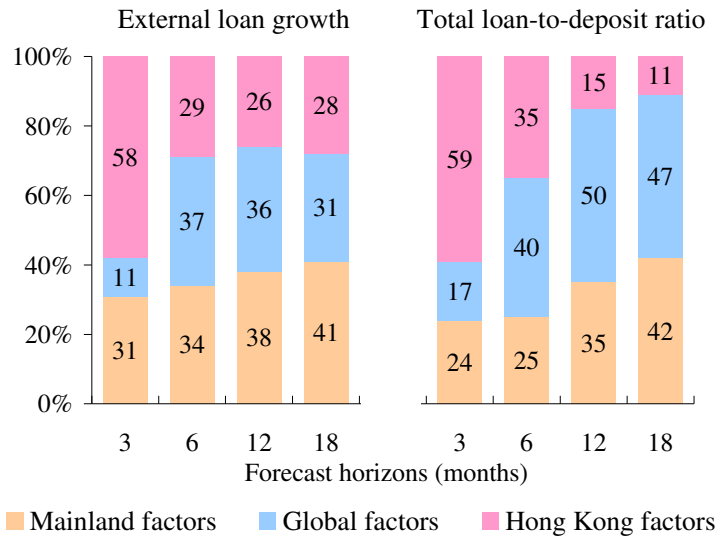
Table 4: Forecast error variance decomposition of external loan growth and total loan-to-deposit ratio

Forecast Horizon (Months)	Variance Decomposition (%)		
	Global	Mainland	HK
	A. External loans		
3	11	31 (31)	58
6	37	34 (33)	29
12	36	38 (36)	26
18	31	41 (37)	28
	B. Total loan-to-deposit ratio		
3	17	24 (22)	59
6	40	25 (24)	35
12	50	35 (33)	15
18	47	42 (40)	11

Note: The numbers in brackets indicate the importance of monetary conditions on the Mainland (by excluding the impact of Mainland industrial production).

The decomposition shows that, on average during 2003 – 2011, Mainland shocks explained roughly 25 - 40% of the forecasting errors of Hong Kong's external loan growth and total LTD ratio. In particular, Mainland shocks were as important as global shocks in explaining the forecasting errors of external loan growth in Hong Kong, but somewhat less important than global shocks in accounting for the errors in the total LTD ratio (Table 4 and Chart 15). While the importance of Mainland shocks in explaining the unexpected changes in external loan growth is roughly stable at the four reported horizons, Mainland shocks' significance in the case of the LTD ratio increases at longer horizons (12 and 18 months). In addition, monetary conditions on the Mainland account for much of the impact that originates from Mainland shocks, with output shocks explaining only a tiny portion of the forecasting errors.

Chart 15: Forecast error variance decomposition



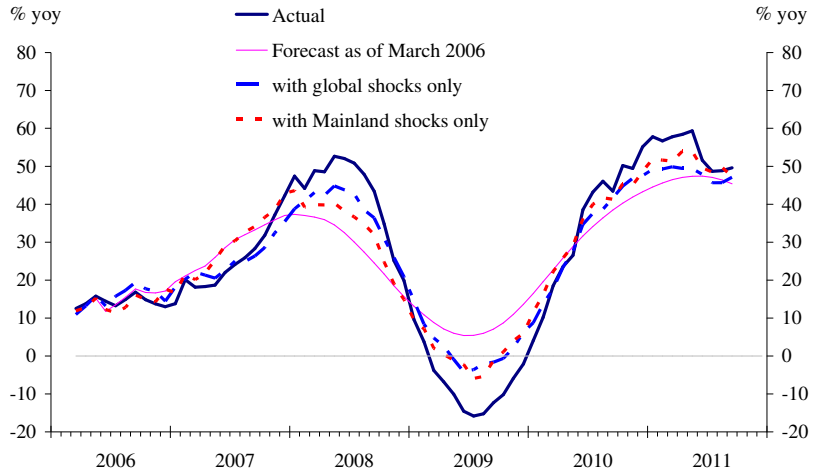
Source: Authors' calculation.

A further statistical exercise — known as *historical decomposition* — is conducted to shed additional light on the importance of Mainland shocks. Specifically, this exercise decomposes the in-sample actual value of external loan growth or the total LTD ratio into a part that is forecast on the basis of the estimated dynamics of the VAR system and a part that depends on shocks that have occurred during a particular period of time. The results on external loan growth are presented in Charts 16 and 17. The solid dark blue line in Chart 16 represents the actual value of external loan growth, and the solid purple line represents the forecast based on data until early 2006, which effectively means that it is based on the assumption that there will be no shocks from then onwards. The dashed blue line represents the forecast path plus the effects of the actual shocks to global variables from March 2006 onwards, and similarly the dashed red line represents the forecast path plus the effects of the actual shocks to Mainland variables. Chart 17 shows the respective contributions of global shocks, Mainland shocks and Hong Kong shocks to the forecast errors.

The historical decomposition shows that global and Mainland factors accounted for significant and time-varying portions of the unexpected movements in external loan growth, generally causing a positive impact in 2008, 2010 and 2011 but a negative impact in 2009. Thus the dashed blue line and dashed red line display pro-cyclical movements around the solid purple line during those periods (Chart 16). In addition, although virtually all of the unexpected variations in external loan growth could be explained by global and Mainland shocks, their relative importance varied over time (Chart 17).

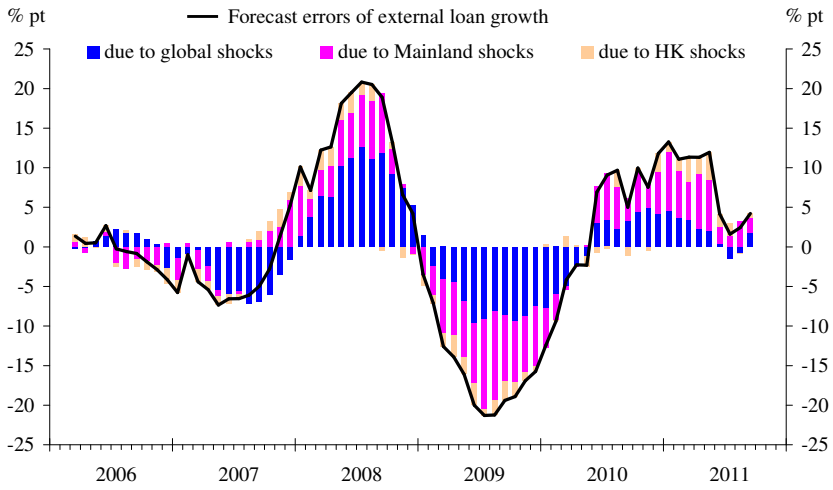
In particular, Mainland shocks appear to have played a relatively more important role in the credit up-cycle in 2010 – 2011 than in 2008. This seems consistent with the view that the extraordinary loan growth during 2010 – 2011 was mainly driven by Mainland-related demands.

Chart 16: Historical decomposition of year-on-year external loan growth



Source: Authors' calculation.

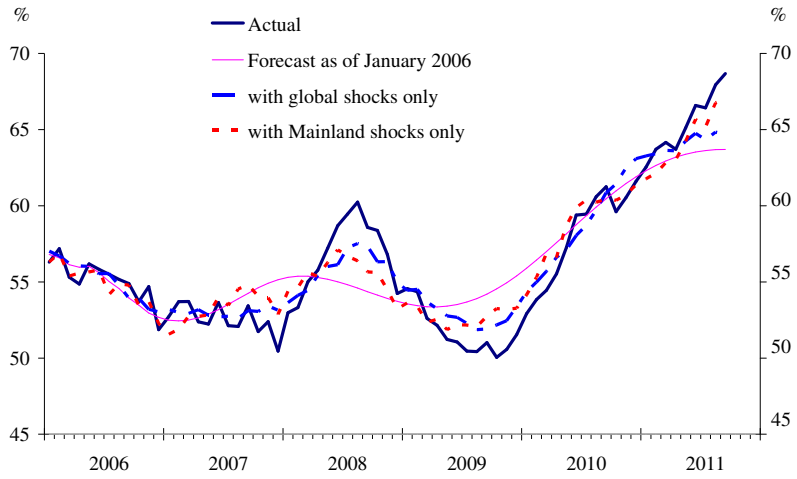
Chart 17: Decomposition of forecast errors of external loan growth



Source: Authors' calculation.

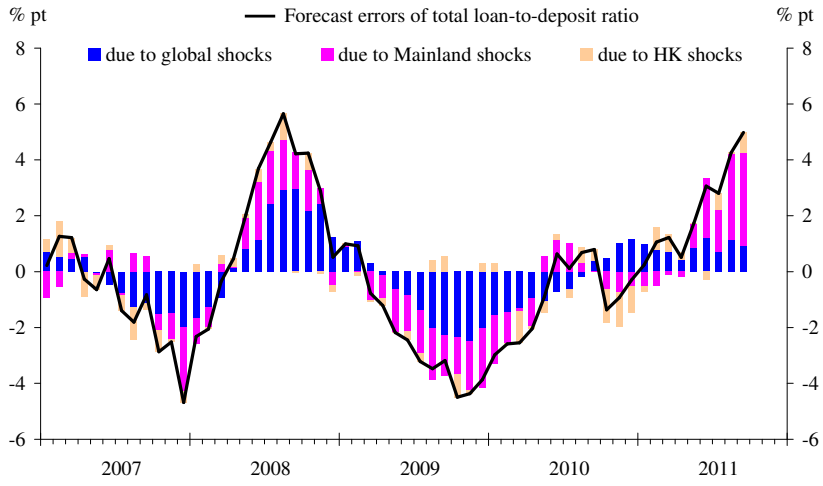
The same historical decomposition method applied to the total LTD ratio gives rise to similar results. Both global and Mainland factors accounted for a significant part of the unexpected movements in the LTD ratio during January 2006 – September 2011 (Chart 18). Almost all of the unexpected variations in the ratio could be attributed to global and Mainland shocks, with the latter's influence particularly visible towards the end of the sample period, perhaps reflecting the lagged impact of the monetary policy tightening on the Mainland (Chart 19).

Chart 18: Historical decomposition of the total loan-to-deposit ratio



Source: Authors' calculation.

Chart 19: Decomposition of forecast errors of the total loan-to-deposit ratio



Source: Authors' calculation.

V. CONCLUDING REMARKS

This paper builds on previous research and attempts to add to our understanding of the effects of Mainland factors, particularly the monetary conditions, on Hong Kong's credit developments. Results show that higher carrying costs of borrowing on the Mainland — reflected by the Mainland's RMB policy rates, USD interest rate differential, and expectations of RMB appreciation — tend to lead to faster growth in Hong Kong's external loans and higher LTD ratios. Likewise, a tighter-than-expected quantitative access to credit on the Mainland — as proxied by the RRR policy — appears to generate similar effects. On the other hand, faster RMB loan growth on the Mainland tends to be associated with faster external loan growth and higher LTD ratios in Hong Kong, possibly driven by unobserved credit demand factors.

The quantitative results should be interpreted with caveats. First, constrained by data availability, our sample period is relatively short, with a significant part of it coinciding with an episode of unusually large global volatility. Thus our estimates are best regarded as indicative and could differ from the representative effects that would prevail in a more tranquil time period. Secondly, while already visible in many cases, the results may still have understated the *current* effect of Mainland factors, as our empirical exercise measures the *average* effect over the whole sample period. With Hong Kong banks' direct exposures to the Mainland having increased rapidly in recent years, the impact of Mainland shocks might have become more important than is suggested by our results.

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Annex A

Details on the 11-variable VAR model

Vector auto-regression (VAR) model

Two VAR models are estimated, one for external loans and another for the total loan-to-deposit (LTD) ratio. Each estimated VAR model contains 11 variables: (1) G3 industrial production, (2) 12-month US dollar LIBOR, (3) US dollar nominal effective exchange rate, (4) Mainland industrial production, (5) Mainland RRR, (6) Mainland policy interest rate, (7) Mainland RMB loans, (8) 12-month expected changes in RMB exchange rate against the US dollar, (9) the difference between 12-month US dollar lending interest rate on the Mainland and LIBOR, (10) Hong Kong total merchandise trade value and (11) the variable of interest (either external loans or the total LTD ratio in Hong Kong).[16] Some time series (industrial production, loans and trade value) are transformed into year-on-year growth to ensure stationarity before estimation. Chart A1 plots the data. The sample is composed of monthly data from early 2003 to September 2011. The number of lags is five for the model of external loans and three for the model of the total LTD ratio.[17]

Response of external loans or total LTD ratio to shocks

We use the impulse response function analysis to trace out the model's reaction to a current shock in one of the VAR variables. A Choleski decomposition is imposed based on the ordering described above. Implicit in this ordering, it is assumed that, because of the size of the G3 or US economy, the global or US shocks will have immediate effects on both Hong Kong and the Mainland, but not the other way round. Likewise, because of the small size of Hong Kong relative to the Mainland, Mainland shocks are assumed to be transmitted at once to Hong Kong but not the other way round. In addition,

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[16] The number and the choice of variables in the model involve a trade-off. Ideally, all variables that may have significant impacts on external loans or the total LTD ratio should be included in the model. However, the number of variables to be included is practically constrained by the need to retain adequate degrees of freedom.

[17] Mixed results are obtained using information criteria to determine the number of lags. We therefore start with a large number of lags and use the lag exclusion test and the stationarity of the VAR system to help determine an optimal lag length. Some researchers recommend including lags covering more than one year to capture seasonal effects. An 11-variable VAR model and a sample size of around 100, however, exclude such a choice. A longer lag structure could yield the benefit of better capturing the dynamic interactions, but might risk over-fitting the model. Partly reflecting this consideration, the time series are seasonally adjusted where appropriate.

standard economic theories and the results of Granger Causality tests are used to determine the rest of the ordering. In general, the variables are ordered to the effect that a particular variable will respond contemporaneously to shocks to the preceding variables but not to shocks to the variables after. For example, it is assumed that Hong Kong total merchandise trade value responds contemporaneously to global and Mainland shocks but not to shocks of Hong Kong's external loan growth.

Chart A1: Data plots of the VAR variables