An Empirical Study on the Linkage Between Offshore and Onshore Interbank Offered Rate

Wen-wen ZENG
Nanjing University of Science and Technology, Nanjing, Jiangsu, China
2933549272@qq.com

Keywords: CNH-HIBOR, SHIBOR, Linkage, VAR Model.

Abstract. This article uses Granger causality test and vector autoregression model to investigate the linkage between SHIBOR and CNH-HIBOR. The results showed that the existence of linkage between two short-term varieties, long-term varieties did not show linkage, and the offshore market has an impact on the onshore market, short-term maturity varieties respond more rapidly to impacts, while long-term maturity varieties respond to impacts that take a long time to digest. The results show that the linkage between China’s inter-bank lending rate and the onshore market is gradually increasing, it’s need to further strengthen SHIBOR’S s the basic position, and constantly improve the quotation mechanism and relax offshore market restrictions.

1. Introduction
CNH-Hongkong Inter-bank Offered Rate (CNH-HIBOR) reflects the interest rate level of the offshore RMB market. If the offshore market and onshore market interest rates spread too much, it can easily lead to arbitrage, which is not conducive to the stability and security of the market economy stability and security. Therefore, studying the linkage of inter-bank lending rates will be conducive to promoting marketization of interest rates. The domestic research on the inter-bank lending rate mainly focuses on three aspects: factors that influence the inter-bank lending rate [1]; benchmark interest rate [2,3]; volatility of the inter-bank lending rates [4-7].

Based on the existing research results, this paper uses the Granger causality test and vector autoregressive model to analyze the offshore market and onshore market.

2. Data Stationarity Test

2.1 Selection and description of indicators
In this paper, we choose the interbank offered rate of Hong Kong to represent the interest rate of offshore RMB market, choose the interest rate of Shanghai RMB bank interbank offered rate to represent the RMB onshore market, and choose O/N, 1 week (1W), 2 weeks (2W), 1 month (1M), 3 months (3M), 6 months (6M) and 1 year (1Y). The samples were selected from July 15, 2015 to July 19, 2017. The data of Hong Kong interbank offered rates came from the Hong Kong Monetary Authority. The data of Shanghai interbank offered rates came from the National Interbank Funding Center. In the meantime, due to the different holiday arrangements in Hong Kong and the Mainland, the data of interest rates at the time of departure are excluded when the data are processed. The sample size is 478.

This paper chooses the logarithmic difference of the interest rate unit root test, and the same treatment was also conducted by Zhou Xianping [8]. In the article lonh, lowh, ltwh, lomh, ltmy, loyh on behalf of the overnight, 7, 14, one month, three months, 1 year offshore market RMB interest rate of return, lony, lowy, ltwy, lony, ltmh, loyy respectively on behalf of the overnight, 7, 14, one month, three months, 1-year onshore market RMB interest rate yields.

2.2 Interest rate linkage test
This paper builds a vector autoregression (VAR) model based on the above seven groups of offshore interest rates and onshore interest rate series and conducts a Granger causality test.
<table>
<thead>
<tr>
<th>Period</th>
<th>The optimal lag order</th>
<th>Null hypothesis</th>
<th>F statistic</th>
<th>P value</th>
<th>Judgment</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>2</td>
<td>lonh doesn’t Granger cause lony</td>
<td>5.6011</td>
<td>0.0039</td>
<td>Reject the null hypothesis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>lonh doesn’t Granger cause lony</td>
<td>1.4619</td>
<td>0.2328</td>
<td>Cannot reject the null hypothesis</td>
</tr>
<tr>
<td>1W</td>
<td>2</td>
<td>lowh doesn’t Granger cause lowy</td>
<td>0.6521</td>
<td>0.5214</td>
<td>Cannot reject the null hypothesis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>lowh doesn’t Granger cause lowy</td>
<td>3.5434</td>
<td>0.0297</td>
<td>Reject the null hypothesis</td>
</tr>
<tr>
<td>2W</td>
<td>5</td>
<td>Itmy doesn’t Granger cause Itmy</td>
<td>0.5046</td>
<td>0.7729</td>
<td>Cannot reject the null hypothesis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Itmy doesn’t Granger cause Itmy</td>
<td>2.3545</td>
<td>0.0397</td>
<td>Reject the null hypothesis</td>
</tr>
<tr>
<td>1M</td>
<td>7</td>
<td>lomy doesn’t Granger cause lomy</td>
<td>2.1025</td>
<td>0.0420</td>
<td>Reject the null hypothesis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>lomy doesn’t Granger cause lomy</td>
<td>1.5740</td>
<td>0.1410</td>
<td>Cannot reject the null hypothesis</td>
</tr>
<tr>
<td>3M</td>
<td>5</td>
<td>Itmh doesn’t Granger cause Itmy</td>
<td>2.1753</td>
<td>0.0558</td>
<td>Cannot reject the null hypothesis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Itmh doesn’t Granger cause Itmy</td>
<td>1.6728</td>
<td>0.1397</td>
<td>Cannot reject the null hypothesis</td>
</tr>
<tr>
<td>6M</td>
<td>7</td>
<td>Ismy doesn’t Granger cause Ismy</td>
<td>1.0150</td>
<td>0.4197</td>
<td>Cannot reject the null hypothesis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ismy doesn’t Granger cause Ismy</td>
<td>1.3800</td>
<td>0.2117</td>
<td>Cannot reject the null hypothesis</td>
</tr>
<tr>
<td>1Y</td>
<td>1</td>
<td>loyh doesn’t Granger cause loyh</td>
<td>1.2492</td>
<td>0.2643</td>
<td>Cannot reject the null hypothesis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>loyh doesn’t Granger cause loyh</td>
<td>0.0152</td>
<td>0.9019</td>
<td>Cannot reject the null hypothesis</td>
</tr>
</tbody>
</table>

### 2.3 VAR model analysis

Based on the previous Granger causality test, this paper selects the yield sequences of ON, 1W, 2W maturity breeds to describe the dynamic interaction between short-term Shanghai Interbank Offered Rate (SHIBOR) and CNH-HIBOR from the maturing varieties with mutual influence.

### 2.4 ON VAR model analysis

Combined with AIC, SC information criterion and LR test, the model results as follows:

\[
\begin{bmatrix}
  lony \\
  lonh
\end{bmatrix} =
\begin{bmatrix}
  -0.0570 & 0.0099 \\
  -3.1840 & -0.0072
\end{bmatrix}
\begin{bmatrix}
  lony \\
  lonh
\end{bmatrix}_{(t-1)} +
\begin{bmatrix}
  0.0674 & 0.0022 \\
  0.6907 & -0.1109
\end{bmatrix}
\begin{bmatrix}
  lony \\
  lonh
\end{bmatrix}_{(t-2)} +
\begin{bmatrix}
  0.0016 \\
  0.0046
\end{bmatrix}
\]

It can be seen from impulse response analysis, lony makes a positive response to the positive impact of lonh, reaching the maximum at stage 2, and soon settles at stage 4. The positive impact of lonh on lony makes a positive reaction in the first phase, a negative reaction in the second phase, and a positive reaction in the third phase.

By variance decomposition, lonh’s contribution to lony’s prediction error reaches its maximum at period 7, reaching 0.25% and stabilizing in the next 4 periods. Lony’s lonh prediction error reached the maximum in the eighth period, reaching 3.07%, and the latter three periods remained stable.
Table 2. Variance decomposition of lowh and lony (%).

<table>
<thead>
<tr>
<th>Period</th>
<th>S.E.</th>
<th>LONLY</th>
<th>LONH</th>
<th>Period</th>
<th>S.E.</th>
<th>LONLY</th>
<th>LONH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.01727</td>
<td>100</td>
<td>0</td>
<td>1</td>
<td>0.368226</td>
<td>0.832383</td>
<td>99.16762</td>
</tr>
<tr>
<td>2</td>
<td>0.0173</td>
<td>99.9612</td>
<td>0.038799</td>
<td>2</td>
<td>0.372355</td>
<td>3.014125</td>
<td>96.98588</td>
</tr>
<tr>
<td>3</td>
<td>0.017362</td>
<td>99.75349</td>
<td>0.24651</td>
<td>3</td>
<td>0.374865</td>
<td>3.070298</td>
<td>96.9297</td>
</tr>
<tr>
<td>4</td>
<td>0.017364</td>
<td>99.75206</td>
<td>0.247938</td>
<td>4</td>
<td>0.374871</td>
<td>3.07164</td>
<td>96.92836</td>
</tr>
<tr>
<td>5</td>
<td>0.017365</td>
<td>99.75162</td>
<td>0.248377</td>
<td>5</td>
<td>0.374911</td>
<td>3.07145</td>
<td>96.92855</td>
</tr>
<tr>
<td>6</td>
<td>0.017365</td>
<td>99.75162</td>
<td>0.248377</td>
<td>6</td>
<td>0.374911</td>
<td>3.07145</td>
<td>96.92855</td>
</tr>
<tr>
<td>7</td>
<td>0.017365</td>
<td>99.75159</td>
<td>0.248409</td>
<td>7</td>
<td>0.374912</td>
<td>3.071451</td>
<td>96.92855</td>
</tr>
<tr>
<td>8</td>
<td>0.017365</td>
<td>99.75159</td>
<td>0.248409</td>
<td>8</td>
<td>0.374912</td>
<td>3.071452</td>
<td>96.92855</td>
</tr>
<tr>
<td>9</td>
<td>0.017365</td>
<td>99.75159</td>
<td>0.248409</td>
<td>9</td>
<td>0.374912</td>
<td>3.071452</td>
<td>96.92855</td>
</tr>
<tr>
<td>10</td>
<td>0.017365</td>
<td>99.75159</td>
<td>0.248409</td>
<td>10</td>
<td>0.374912</td>
<td>3.071452</td>
<td>96.92855</td>
</tr>
</tbody>
</table>

2.5 1W VAR model analysis

Combined with AIC, SC information criterion and LR test, the model results are as follows:

\[
\begin{bmatrix}
    \text{lowy} \\
    \text{lowh}
\end{bmatrix}
= 
\begin{bmatrix}
    0.2937 & -0.0042 \\
    -0.6157 & -0.0747
\end{bmatrix}
\begin{bmatrix}
    \text{lowy} \\
    \text{lowh}
\end{bmatrix}^{(t-1)}
+ 
\begin{bmatrix}
    -0.0028 & 0.0001 \\
    1.5183 & -0.0706
\end{bmatrix}
\begin{bmatrix}
    \text{lowy} \\
    \text{lowh}
\end{bmatrix}^{(t-2)}
+ 
\begin{bmatrix}
    0.0002 \\
    0.0003
\end{bmatrix}
\]  \hspace{1cm} (2)

It can be seen from impulse response analysis that the lowh positive response to lowy basically makes a positive response and reaches the maximum in the second period, which is attributed to the stable in the fourth period. Lowy’s positive impact on lowh made the positive reaction in the first phase, negative reaction in the second phase, and the return to the stable phase at the third phase.

Table 3. Variance decomposition of lowy and lowh (%).

<table>
<thead>
<tr>
<th>Period</th>
<th>S.E.</th>
<th>LOWH</th>
<th>LOWY</th>
<th>Period</th>
<th>S.E.</th>
<th>LOWH</th>
<th>LOWY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.2212</td>
<td>100</td>
<td>0</td>
<td>1</td>
<td>0.007523</td>
<td>0.491755</td>
<td>99.50824</td>
</tr>
<tr>
<td>2</td>
<td>0.221888</td>
<td>99.95664</td>
<td>0.043359</td>
<td>2</td>
<td>0.007877</td>
<td>1.388483</td>
<td>98.61152</td>
</tr>
<tr>
<td>3</td>
<td>0.222516</td>
<td>99.73916</td>
<td>0.260841</td>
<td>3</td>
<td>0.007904</td>
<td>1.403308</td>
<td>98.59669</td>
</tr>
<tr>
<td>4</td>
<td>0.222533</td>
<td>99.72658</td>
<td>0.273417</td>
<td>4</td>
<td>0.007905</td>
<td>1.403366</td>
<td>98.59663</td>
</tr>
<tr>
<td>5</td>
<td>0.222534</td>
<td>99.72658</td>
<td>0.273416</td>
<td>5</td>
<td>0.007905</td>
<td>1.403347</td>
<td>98.59665</td>
</tr>
<tr>
<td>6</td>
<td>0.222534</td>
<td>99.72658</td>
<td>0.273417</td>
<td>6</td>
<td>0.007905</td>
<td>1.403358</td>
<td>98.59664</td>
</tr>
<tr>
<td>7</td>
<td>0.222534</td>
<td>99.72658</td>
<td>0.273472</td>
<td>7</td>
<td>0.007905</td>
<td>1.403358</td>
<td>98.59664</td>
</tr>
<tr>
<td>8</td>
<td>0.222534</td>
<td>99.72658</td>
<td>0.273421</td>
<td>8</td>
<td>0.007905</td>
<td>1.403358</td>
<td>98.59664</td>
</tr>
<tr>
<td>9</td>
<td>0.222534</td>
<td>99.72658</td>
<td>0.273421</td>
<td>9</td>
<td>0.007905</td>
<td>1.403358</td>
<td>98.59664</td>
</tr>
<tr>
<td>10</td>
<td>0.222534</td>
<td>99.72658</td>
<td>0.273421</td>
<td>10</td>
<td>0.007905</td>
<td>1.403358</td>
<td>98.59664</td>
</tr>
</tbody>
</table>

By analysis of variance decomposition, the contribution of lowy impact to lowh prediction error reaches the maximum value of 1.4% in the sixth period and remains stable in the next four periods. The contribution of lowh’s impact on lowy prediction error reached a maximum of 0.27% at the 7th and remained stable in the latter three phases.

2.6 2W VAR model decomposition

Combined with AIC, SC information criterion and LR test, the model results are as follows:
\[
\begin{bmatrix}
ltwy \\
lthw
\end{bmatrix}
= 
\begin{bmatrix}
0.3493 & -0.0062 \\
-0.7927 & -0.1084
\end{bmatrix}
\begin{bmatrix}
ltwy \\
lthw
\end{bmatrix}
(t-1) + 
\begin{bmatrix}
0.0411 & -0.0034 \\
0.3214 & -0.0755
\end{bmatrix}
\begin{bmatrix}
ltwy \\
lthw
\end{bmatrix}
(t-2) + 
\begin{bmatrix}
-0.0120 & 0.0037 \\
0.1143 & -0.1281
\end{bmatrix}
\begin{bmatrix}
ltwy \\
lthw
\end{bmatrix}
(t-3) + 
\begin{bmatrix}
0.0451 & -0.0005 \\
-1.1066 & 0.0682
\end{bmatrix}
\begin{bmatrix}
ltwy \\
lthw
\end{bmatrix}
(t-4) + 
\begin{bmatrix}
-0.0351 & -0.0026 \\
0.1797 & -0.0552
\end{bmatrix}
\begin{bmatrix}
ltwy \\
lthw
\end{bmatrix}
(t-5) + 
\begin{bmatrix}
0.0003 \\
0.0013
\end{bmatrix}
\begin{bmatrix}
ltwy \\
lthw
\end{bmatrix}
(t-6)
\]

\[\text{(3)}\]

It can be seen from impulse response analysis, \(ltwh\) positive reaction to \(ltwy\) response is relatively small, positive reaction in the first period, followed by a weak negative reaction. The positive impact of \(ltwy\) on \(ltwh\) made the positive reaction in the fourth period, the weak positive and negative responses fluctuated, and the return to the steady state at the end of the eighth period.

### Table 4. Variance decomposition of \(ltwy\) and \(ltwh\).

<table>
<thead>
<tr>
<th>Period</th>
<th>S.E.</th>
<th>LTWH</th>
<th>LTWY</th>
<th>Period</th>
<th>S.E.</th>
<th>LTWH</th>
<th>LTWY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.009685</td>
<td>0.024142</td>
<td>99.97586</td>
<td>1</td>
<td>0.179759</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0.010303</td>
<td>1.210284</td>
<td>98.78972</td>
<td>2</td>
<td>0.181016</td>
<td>99.91189</td>
<td>0.088111</td>
</tr>
<tr>
<td>3</td>
<td>0.010453</td>
<td>1.910922</td>
<td>98.08908</td>
<td>3</td>
<td>0.181166</td>
<td>99.91106</td>
<td>0.088944</td>
</tr>
<tr>
<td>4</td>
<td>0.010476</td>
<td>1.948753</td>
<td>98.05125</td>
<td>4</td>
<td>0.181181</td>
<td>99.91107</td>
<td>0.088931</td>
</tr>
<tr>
<td>5</td>
<td>0.01048</td>
<td>1.955881</td>
<td>98.04412</td>
<td>5</td>
<td>0.181181</td>
<td>99.91103</td>
<td>0.088972</td>
</tr>
<tr>
<td>6</td>
<td>0.010481</td>
<td>1.957914</td>
<td>98.04209</td>
<td>6</td>
<td>0.181181</td>
<td>99.91103</td>
<td>0.088973</td>
</tr>
<tr>
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<td>1.958238</td>
<td>98.04176</td>
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<td>0.181181</td>
<td>99.91103</td>
<td>0.088973</td>
</tr>
<tr>
<td>8</td>
<td>0.010481</td>
<td>1.958293</td>
<td>98.04171</td>
<td>8</td>
<td>0.181181</td>
<td>99.91103</td>
<td>0.088973</td>
</tr>
<tr>
<td>9</td>
<td>0.010481</td>
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<td>98.0417</td>
<td>9</td>
<td>0.181181</td>
<td>99.91103</td>
<td>0.088973</td>
</tr>
<tr>
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<td>1.958306</td>
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<td>10</td>
<td>0.181181</td>
<td>99.91103</td>
<td>0.088973</td>
</tr>
</tbody>
</table>

By analysis of variance decomposition, the contribution of \(ltwy\) impact to \(ltwh\) prediction error reached the maximum value of 0.09% in the sixth period, and remained stable after the fourth period. The contribution of \(ltwh\)'s impact on \(ltwy\) prediction error reaches a maximum of 1.96% at the 10th stage, and the latter three stages of change slow down.

This shows that as the onshore RMB market matures, the impact of the RMB inter-bank lending rate on the offshore RMB inter-bank lending rate will be lessened. The same situation occurs in the inter-bank lending rates of two kinds of periods of 1 week and 2 weeks, and the changes after the impact are obviously smaller. This shows that the dependence of the offshore RMB inter-bank lending market on the onshore RMB interbank lending market is decreasing, autonomy increased. 1M showed one-way guidance on offshore interest rates on offshore interest rates. However, there was no clear linkage between off-shore interbank interest rates in, 3M, 6M and 1Y.

### 3. Conclusion and Suggestion

#### 3.1 Basic conclusion

First, the linkage effect between offshore and onshore RMB interest rates has existed initially, specifically in interest rates of overnight, one week and two weeks. Second, on the overnight of the bank, the January interest rate still has a one-way guidance on offshore overnight rates. However, in three months, six months, the one-year inter-bank lending rate did not show any linkage with the onshore market.

#### 3.2 Forcing effect

Through empirical research, for the 1-week and 2-week interest rate varieties, it shows that there is a force-in effect of the offshore interest rate on the onshore rate.
3.3 Realization of interest rate linkage

In summary, the empirical results of this paper prove that the overnight effect of overnight interest rates on onshore interest rates is not significant, indicating that there is still a gap between the offshore RMB interest rate in Hong Kong and the mature offshore interest rate system. How to strengthen SHIBOR’s basic position and improve the quotation mechanism and relax offshore market restrictions? First of all, we should continue to promote market-oriented RMB interest rate reform. Secondly, it is important to strengthen the financial cooperation between Hong Kong and the Mainland of China, and the close contact between Hong Kong and the Mainland. The authorities in Hong Kong and the Mainland should work together to formulate regulatory procedures to strengthen the monitoring and analysis capabilities and guard against the potential risks arising from the abnormal flow of RMB.

References


