A Network View of Capital Market Integration and Disintegration- An Example by VAR Model

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Abstract: Traditional empirical work on market integration based on looking at two countries at a time. This paper uses interaction between members (spillover effect) to examine the market integration and disintegration. Asian Currency Crisis in 1997 was said to happen because high market integration made crisis in one country contagious (through spillover effect) to other countries and caused the disaster. This paper chooses 7 Asian countries –Hong Kong, Singapore, Taiwan, Malaysia, Korea, Thailand and Indonesia –to study the integration and disintegration through interest rate spillover effect (lead-lad relationship) among them. This paper examines how the spillover effect worked before the crisis and how this relationship changed after the crisis. VAR (Vector Autoregressive) model is used to analyze the multivariate spillover effects. This paper examines capital market integration periods before and after crisis separately. We found that before Asian currency crisis, the market integration is strong. After Asian currency crisis, regional integration decreased and the spillover effects among the members in this region changed. The only exception is that Taiwan had the same spillover effect as before.

Key-Words: Capital market integration, VAR.
1 Introduction

Asian countries are facing a process of financial market liberalization and growing capital flows over the past 20 years. For economic development, Asian Pacific countries like Korea, Hong Kong, Singapore and Taiwan, etc are gradually deregulating domestic financial market and relaxing restrictions on international capital flows from 1980, which makes Asian Pacific area one of the fastest economic growth area. Therefore, the influence of financial liberalization on Asian countries is particularly worthy of being studied.

The changing degree of capital mobility—broadly defined as the degree of linkage between interaction of domestic and international interest rates—can help us to understand the influence on market interaction and integration after financial liberalization. With deregulation or relaxation in financial restrictions (i.e. financial liberalization), capital inflow or outflow increases (the interest rates interaction increases), and the differential between domestic and international interest rates will gradually get reduced (by Interest Rate Parity). According to Interest Rate Parity (IRP), if we assume rational expectation, domestic interest rate (i) should be equal to international interest rate (i*) and then there is no chance for arbitrage. In financial market integration point of view, if there exists interest rate differential in two countries, then it represents the degree of market segmentation and obstacle of capital mobility. Therefore, we can use interest rate differential as a measurement of international capital mobility. In Frankel(1991), he uses interest rate differentials to measure capital mobility and market integration in the 1980’s for 25 countries. The international interest rate is US interest rate. He calculated the means and standard errors and his empirical result is quite consistent with his own prior expectations: the five closed LDC’s have the highest variability and five open Atlantic countries have the lowest variability. However, there are some exceptions. For example, he found that though France has very strict financial regulations during that time, it has smaller interest rate differentials than Japan, the Netherlands and Switzerland—countries known as highly free of capital controls. Moreover, he found that no interest rate differential is zero of any country. It means that there still exits barriers of capital mobility in these countries.

2. Problem Formulation

This paper will use VAR as the structure of estimation of spillover effect. To study cointegration of
interest rates between these countries, we use VAR to analyze the multivariate time series behavior. We also substitute Japanese interest rate for US interest rate as benchmark interest rate because Japanese interest rate might have more impact on Asian countries.

As we know that Asian currency crisis happened in 1997. According to Figure 1, we can find that there is possible a structure change around 1997 (index 140). The volatility of HK, Singapore, Indonesia and Malaysia became unusually high than before. The only exception is Taiwan. To study this structural change (Asian Currency Crisis in 1997), therefore, besides dealing with the whole period data, perhaps we can split the data into two periods: one is from January 1986 to December 1996, and the other period is from January 1997 to December 1999. We want to know whether the property of the times series changes due to this structure change and whether this structure change has huge influence on the spillover effect among these countries. Finally we want to discuss a little bit of why Taiwan is kind of an exception.

VAR Model

Let \( Y_{t,j} = i_{t,j} \), the interest rate in country \( j \) at time \( t \), where \( j = \) Hong Kong, Taiwan, Singapore, Malaysia, Korea, Thailand and Indonesia. To construct VAR model,

\[
Y = XB + U , \text{ where}
\]

\[
Y = [Y_{hk}, Y_{singapore}, Y_{taiwan}, Y_{malaysia}, Y_{indonesia}, Y_{Korea}, Y_{Thailand}] (T \times K),
\]

\[
X = [1, Y_{t-1}, Y_{t-2}, \ldots, Y_{t-p}] (T \times (1+K*P)),
\]

\[
B = [v, A_1, A_2, \ldots, A_p]' (1+K*P) \times K, \]

\[
U = [u_{hk}, u_{singapore}, u_{taiwan}, u_{malaysia}, u_{indonesia}, u_{Korea}, u_{Thailand}] (T \times K),
\]

And \( T=168, K=7 \)

To get \( B \), we use vec operator:

\[
y = vec(Y) = vec(XB) + vec(U) = (I \otimes X)vec(B) + vec(U) = (I \otimes (X'X)^{-1} X')y
\]

3. Problem Solution

PART I Pre-Currency Crisis Period
(Jan 1986 ~ Dec 1996)

3.1 Unit Root Test:

First of all, we want to know whether there are unit roots in this period. Asymptotic Critical Values under \( \alpha=0.5 \) for \( t \), \( F \) and KPSS Tests are \(-2.86,4.59 \) and \( 0.146 \) respectively.

3.2 Identification: Lag Selection

We found that minimum
AIC, HQ, FPE and SC goes to lag 1. Therefore we choose VAR(1) for pre-period model.

### 3.3 Estimation (Pre period) : 01/1986 – 12/1997

**Asian Pacific Countries**

**Interest Rate Spillover Effect**

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<th>Hong Kong</th>
<th>Singapore</th>
<th>Taiwan</th>
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<td>HK</td>
<td>0.275(0.03)* 0.519(0.01)* 0.595(0.03)* 0.709(0.05)* 0.581(0.04)* 0.472(0.07)* 0.623(0.12)*</td>
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<td>Sing</td>
<td>0.798(0.07)* 0.275(0.01)* 0.27(0.09)* 0.227(0.01)* 0.454(0.06)* 1.49(0.14)* 0.382(0.02)*</td>
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<td>0.812(0.04)* 0.016(0.02)* 0.20(0.07)* 0.655(0.01)* 0.352(0.01)* 0.286(0.02)* 0.625(0.01)*</td>
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<td>Malay</td>
<td>-0.043(0.03) 0.158(0.01)* 0.365(0.03)* 0.169(0.02)* 0.035(0.05)* 0.451(0.12)*</td>
<td>0.03(0.02)* 0.02(0.08)* 0.02(0.12)*</td>
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<td>Korea</td>
<td>0.075(0.04) 0.19(0.05)* 0.752(0.01)* 0.612(0.02)* 0.245(0.04)* 0.25(0.02)* 0.542(0.01)*</td>
<td>0.25(0.04)* 0.02(0.02)* 0.02(0.02)* 0.04(0.01)* 0.11(0.02)*</td>
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<td>Thai</td>
<td>0.012(0.02) -0.034(0.02) -0.017(0.03)* 0.521(0.03)* 0.301(0.03)* 0.033(0.02)* 0.274(0.03)*</td>
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3.4 Diagnostic:

**Cointegration Test**

The critical values in 95% confidence interval are –2.83 for t test, 4.59 for F test and 0.146 for KPSS test.

It tell us that the residuals are I(1). Therefore, there exists cointegration and we can estimate the model directly.

**Part II Post-Currency Crisis Period (Jan 1997 ~ Dec 1999)**

3.5 Unit Root Test

Asymptotic Critical Values under $\alpha=0.5$ for t, F and KPSS Tests are –2.83, 4.59 and 0.146 respectively. We found that the data still have unit root; therefore, we need to test cointegration.

3.6 Identification: Lag Selection

Because all the minimal criteria goes to two, so we choose VAR(2).

3.7 Estimation (post period): 01/1997 -12/1999

**Asian Pacific Countries**

**Interest Rate Spillover Effect**
### 3.8. Diagnostic: Cointegration test

The critical values in 95% confidence interval are –2.83 for t test, 4.59 for F test and 0.146 for KPSS test.

According to the result, Taiwan accepted the null hypothesis and is not cointegrated with other countries. If we look at figure 1 again, we found that all the countries have a peak around 1997 (after index 140) except for Taiwan. The intuition is that Taiwan is not affected by Asian Currency crisis to the same degree with other countries.

### 4. Conclusion

We found out that after currency crisis, the spillover effect changes.

1. In post-period, the model changes to VAR(2) instead of VAR(1).
2. HK has spillover effect to Taiwan.
3. Singapore only has spillover effect to Malaysia and Indonesia.
4. Malaysia doesn’t have any spillover effect to others.
5. Thailand doesn’t have any spillover effect to others.
6. Indonesia doesn’t have any spillover effect to others.
7. The spillover effect of Taiwan stays the same: Taiwan has significant spillover effect to HK.

The reason why these spillover effects changes is probably because that the FDI and trade among these countries shrunk after currency crisis. During currency crisis, most of the countries lost huge amount of foreign exchange reserves (Table 15); therefore, government couldn’t use foreign exchange reserve like pre-period to finance its fiscal debt. The only way was to use the money once was used for FDI to liquid government’s debt. Since the capital flows became smaller, the spillover effects in post period became not as significant as that in pre-period.

The reason why Taiwan’s spillover effect stays the same might be explained by its survival in currency crisis. During the whole currency crisis, Taiwan had the slightest suffering from this unexpected shock in these countries. By the end of December 1997, New Taiwan dollar weakened moderately and depreciated about only 10 percent, which the level was only one-third or fifty percent compared to ASEAN-4 countries. We will illustrate it more in detail next.

Reference


