Measuring Economic Integration: The Case of Asian Economies*

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Abstract

We use factor models to investigate the trade and financial integration in the fourteen selected Asian economies. Principal component analysis is used to estimate the integration factors in the trade intensity and interest rate correlation. Our results show that there is a high degree of trade integration in the region whereas there is no strong evidence of the same degree of financial integration. Furthermore, there is no evidence for the existence of a common factor affecting both trade and financial integration. The trade integration is particularly strong in the economies that have common characteristics such as common culture or a trade agreement. However, these particular group factors do not appear in the financial integration.

JEL: F15, F36, F42

Key words: Economic integration, trade intensity, financial integration, interest rate correlation, factor model, principal components

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1. Introduction

After the 1997 Asian financial crisis, both intra-Asia trade and regional financial markets experienced considerable growth. The phenomenon has reinforced the impression that economic integration has been steadily proceeding among the Asian economies. In general, the interest in assessing the degree of economic integration is driven by its implications for economic efficiency, risk sharing, and the feasibility of forming a currency union.

How integrated are the Asian economies? It is not an easy question to answer. Loosely speaking, economic integration refers to increased interactions and strengthened links between economies. According to Eatwell, Milgate and Newman (1987), for example, economic integration is defined "as a process and as a state of affairs. Considered as a process, it encompasses measures designed to eliminate discrimination between economic units that belong to different national states; viewed as a state of affairs, it represents the absence of various forms of discrimination between national economies" (p.43). Translating economic concepts into real-world measures may not be straightforward. Assessing the extent of economic integration is no exception.

In the literature, a number of criteria have been developed to evaluate the degree of economic integration. The criteria can be broadly classified into two categories – price- and quantity-based measures. The quantity-based category includes measurements of openness and restrictiveness in trade and financial transactions, capital flows, output correlation, saving-investment correlation, and consumption correlation.[1] A higher level of openness (or a lower level of restrictiveness) is associated with a higher degree of economic integration.

The price-based category consists of tests derived from price differentials in goods and financial markets. A greater degree of economic integration is implied by a smaller price differential. Variables including interest rates, price indexes, and asset prices have been used to assess integration. Sometimes, the use of macro variables

[1] Sometimes, an alternative category is defined based on regulatory and institutional measures.

such as output, saving, investment, and consumption to assess integration is labeled as the macroeconomic approach while the microeconomic approach refers to the use of (financial and goods) prices.[2]

It is not an exaggeration to say that we have an embarrassment of riches. With these different measures, there is no consensus on which is the most appropriate one to use. In general these measures focus on different aspects and implications of economic integration. We anticipate the multitude of measures, with different implementation methods, will yield different inferences about the degree of integration. For instance, using different approaches, Yu et al. (2007) and McCauley et al. (2002) offer different assessments on the integration of bond markets in Asia. Indeed, a reasonable question to ask is "Which one of the available measures should be used to assess the degree of integration among the Asian economies?"

Instead of arguing in favour of one measure over the other, we propose an alternative framework to assess the degree of integration. The intuition is that, in general, the individual measures focus on different aspects and implications of economic integration and, thus, each one of them by itself does not give a complete picture. Thus, it is useful to combine information from individual measures to form an overall assessment of the degree of integration.

The proposed framework starts with the following premise that integration is driven by common factors that affect all economies, group factors affect economies that share some common characteristics, and there are idiosyncratic factors that are economy-specific. Suppose we have a measure of trade integration and a measure of financial market integration. To combine information from these two measures, we assume there is an overall common factor driving both trade and financial market integration. Further there are common and group factors specific to trade and to financial integration. Thus, for a given economy, its observed degree of integration is decomposed into several components – one is the extent of integration that is associated with the overall common factor that drives both trade and financial market integration, one is associated with factors specific to trade (or financial) market

[2] See Bayoumi (1997).

integration, one is associated with some "group" characteristics, and an idiosyncratic component.

The common factors required to conduct the analysis can be constructed from two approaches. One approach is to assume the common factors are represented by a set of observed economic variables. In this case, we would like to have a theory that relates integration to these variables. A similar remark applies to the use of common elements of these economic variables as proxies of common factors.

Another approach is to assume the common factors are unobservable. We can extract the latent common factors directly from the measures of integration. The approach implicitly assumes that the observed measures of integration contain information on the common force that drives integration. Although the approach is atheoretical, it is quite intuitive and can be implemented easily. Indeed, the technical aspect is drawn mainly from factor models, which have been used to analyze various economic issues. In the current exercise, we will follow the latent common factor approach. The role of selected economic variables will also be explored later.

In the next section, we describe the basic econometric framework and its variants. Section 3 illustrates the practical relevance of the proposed framework. Specifically, the proposed framework is used to examine data on two measures of integration. Some concluding remarks are provided in Section 4.

2. Econometric Framework

To simplify presentation, we first consider the case of one common and one group factor. Then, we discuss the variants of the basic setup. The basic specification is given by

$$X_{ij,t} = \gamma_{ij} F_t + \delta_{ij} Q_{ij,t} + \nu_{ij,t}; \quad i,j = 1, 2, \ldots, \text{N and } i < j, \; t = 1, \ldots, \text{T}, \tag{2.1}$$

where $X_{ij,t}$ is a measure of integration between economies *i* and *j* at time t, F_t is the common factor that affects the level of integration among all the economies, $Q_{ij,t}$ is

the group factor associated with some of the economies in the sample, $\nu_{ij,t}$ is the regression error term that captures the idiosyncratic component of integration, N is the number of economies under consideration, and T gives the time dimension of the sample. To fix the idea, we can interpret $X_{ij,t}$ as a measure of trade integration given by the volume of trade between economies *i* and *j* at time t normalized by their gross domestic products, F_t as a latent variable that summarizes the effects of, say, common economic growth and institutional changes on trade, and $Q_{ij,t}$ as a group variable that signifies whether these two economies share, say, the same culture.

In the literature, Eq. 2.1 is known as a factor model. The specification has been adapted in finance to investigate asset pricing, in macroeconomics to study business cycles, and to generate economic forecasts; see, for example, Chamberlain and Rothschild (1983), Forni and Reichlin (1998), Giannone et al. (2005), and Stock and Watson (1989, 2002a, 2002b). In the current content, it is implicitly assumed that the effects of economic variables on the evolution of global trade integration can be represented by a few estimated factors. Alternatively, one can view F_t as the common component of all the $X_{ij,t}$'s included in the analysis. One advantage of the data-driven approach is that we do not have to commit to a specific theory on the determinants of global trade integration and the specific (dynamic) channels through which these determinants affect integration.

The group factor is included to make the specification relevant for real data analysis. It is conceived that some economies tend to trade between themselves when they share some common culture or have a trade agreement. In the current exercise, we appeal to some observable economy characteristics to define the group factor.

The coefficient, γ_{ij}, pertaining to the common factor effect is allowed to vary across economies. We consider that cross-economy heterogeneity is a real phenomenon and, hence, a homogenous restriction on the global factor coefficients is undesirable. For the same reason, the coefficient δ_{ij} of the group effect is also economy-specific.

Suppose $Y_{ij,t}$ is another measure of integration, say, a measure of financial integration. Its common-group-factors specification is given by

$$Y_{ij,t} = \gamma_{ij} G_t + \delta_{ij} R_{ij,t} + \varepsilon_{ij,t} \tag{2.2}$$

where G_t, $R_{ij,t}$, and $\varepsilon_{ij,t}$ are, respectively, the common, group, and idiosyncratic components of the integration measure $Y_{ij,t}$.

At least for the sake of argument, we assume that the two integration measures, $X_{ij,t}$ and $Y_{ij,t}$, represent different aspects of integration and they individually do not give a complete picture on the integration between the two economies. An analysis that combines information contents from these two measures can be conducted via the system

$$X_{ij,t} = \beta_{ij,x} W_t + \gamma_{ij,x} F_t + \delta_{ij,x} Q_{ij,t} + \nu_{ij,t} \tag{2.3}$$

and

$$Y_{ij,t} = \beta_{ij,y} W_t + \gamma_{ij,y} G_t + \delta_{ij,y} R_{ij,t} + \varepsilon_{ij,t} \tag{2.4}$$

The system (2.3) and (2.4) is a combination of (2.1) and (2.2) with an added variable W_t, which represents the overall common factor that affects, in the current example, both trade and financial market integration. The subscripts of β indicate the effect is via the trade or financial market channel. Thus, the set up allows us to infer an overall (or, to be precise in the current example, a combined) level of integration, integration attributed to the common trade (financial market) factor and integration due to the group trade (financial market) factor.

There are a few remarks. First, the model can be easily modified to accommodate the case in which there are more than two measures of integration and there is more than one factor in W_t, F_t, $Q_{ij,t}$, G_t, and $R_{ij,t}$. Further, the lags of these factors can be incorporated.

Second, the principal component approach can be used to estimate the latent factor F_t. Forni et al. (2000) and Stock and Watson (2002a, b), for example, show that under regularity conditions and for large N and T, the principal component of the $X_{ij,t}$'s is a consistent estimator of the common factor that drives the $X_{ij,t}$'s. Similarly, W_t and G_t are estimated by their respective principal components. The regional factor, on the other hand, is derived from an economy's observed characteristics.

Third, we can allow the effects of these factors to be time-varying. Stock and Watson (2002a) show that the factor model can be consistently estimated even if, for example, the coefficient γ_{ij} displays a certain degree of time variability. Obviously, a time-varying γ_{ij} coefficient is an effective means to account for the possibility that the overall common factor effect displays temporal instability.

Fourth, we have to offer a belated apology for the imprecise use of language. The meaning of the "common" factor is situation-dependent. For instance, F_t is the common factor when only $X_{ij,t}$ is under consideration. When both $X_{ij,t}$ and $Y_{ij,t}$ are considered, W_t is the overall common factor and, strictly speaking, F_t becomes the trade-integration-specific factor. Of course, when we change the sample of economies, the interpretation of the overall common factor will be altered accordingly. Similarly, the meaning of group factor can be situation specific. We will make the interpretations of these factors appropriate to the content of the discussion.

3. Empirical Results

In the aftermath of the 1997 Asian Financial crisis, an intense interest arose in the integration among Asian economies. Part of the interest is driven by the belief that the integration of Asian economies promotes policy coordination and deters future crises. Also, in the discussion of the feasibility of forming an Asian currency union, the level of integration is usually deemed as one of the pre-conditions. Indeed, in the post-crisis period, there is a substantial increase in intra-regional trade and various initiatives, including the development of local bond markets, have been taken to foster integration in the region. To shed some insight on integration, we consider

fourteen economies in the Asian region. These economies are Australia, China, Hong Kong, India, Indonesia, Japan, Korea, Malaysia, New Zealand, Philippines, Singapore, Taiwan, Thailand and Vietnam.

It is quite common to discuss economic integration in terms of trade and financial market integration.[3] It has been found that both trade and financial market integration increase over time and, typically, these two forms of integration go hand in hand, at least in the post-War period.[4] Thus, as an illustration, we use one trade integration and one financial market integration measure in our empirical exercise.

For simplicity, we retain $X_{ij,t}$ as our notation of the measure of trade integration. It is given by:

$$X_{ij,t} = (Ex_{ij} + Ex_{ji})/(GDP_i + GDP_j) \tag{3.1}$$

where Ex_{ij} are the exports of economy i to economy j, Ex_{ji} are the exports of economy j to economy i, GDP_i and GDP_j are the output of economy i and economy j respectively. This notation is also called the trade intensity between the two economies and is scaled by 100 as a percentage of the sum of the two GDPs.

--- Insert Figure 1 here ---

Figure 1 shows nine selected trade intensity series from our sample of fourteen economies in the period from January 1998 to December 2006. It is clear that the trade intensity of China with its trading partners grows significantly over the sample period.

On the other hand, we use $Y_{ij} = corr(IR_i, IR_j)$, the correlation of interest rates of country i and country j over a moving window of twelve months, as the measure of

[3] The discussion on International Monetary Fund related measures is drawn heavily from the Appendix 3.1 of the International Monetary Fund (2002).
[4] See International Monetary Fund (2002). Obstfeld and Taylor (2004) observed that the degree of international integration was greater by some measures at the end of the 1800s.

financial integration.[5] Figure 2 depicts nine selected interest rate correlation series over the sample period from January 2000 to December 2006. Due to insufficient data, Vietnam is taken out and thus we have only thirteen economies for the investigation of financial integration.

--- Insert Figure 2 here ---

As discussed in Section 2, the principal component approach is applied on the trade intensity series to obtain the common factors that drive the growth of the bilateral trade among the sample economies. Table 1 shows the five largest principal components. The largest principal component accounts for around 44% of the total variation. This strong common component indicates a high degree of trade integration among the fourteen sample economies. The five components explain 70% of the total variation.

--- Insert Table 1 here ---

However, the high degree of integration does not show up in the interest rate correlation series. Table 2 describes the five largest principal components from the interest rate correlation series. The first largest principal component only accounts for 16% of the total variation whereas the next three largest principal components each accounts for more than 10% of the total variation. This is not surprising because the interest rate is the instrument of the monetary policy and the economies in the sample[6] are having monetary policy servicing their own economies, in addition to the fact that some of the selected economies have not yet achieved full capital account convertibility.

--- Insert Table 2 here ---

To investigate the significance of the largest principal component (i.e. the common factor F_t in Eq. 2.1) on the variation of the trade intensity series, each series

[5] There are other measures of financial integration, such as interest rate parity conditions and financial openness , see Cheung et al. (2007).
[6] Except Hong Kong which follows US interest rate policy because of its currency board arrangement.

is regressed on the component and the associated variance ratio is depicted in Table 3. For the three large economies in the region, China, Japan and India, the common factor plays a significant role in their bilateral trade with the partners in the region. The average of the variance ratio for each country is shown in the last row of the table. Overall, the evidence of a high degree of trade integration is quite strong.

--- Insert Table 3 here ---

The same investigation is also carried out on the interest rate correlation series. Each interest rate correlation series is regressed on the largest principal component (i.e. the common factor G_t in Eq. 2.2) and the associated variance ratio is shown in Table 4. Contrary to the results in the trade intensity series, the variance ratios are much smaller than those in Table 3, particularly those of China. This may be due to the fact that although in some part of the sample period China was using a fixed exchange rate arrangement, it enjoyed monetary autonomy because of the closed capital account. Furthermore, Japan's monetary policy in the same period was geared to deal with the domestic economic problems.

--- Insert Table 4 here ---

As discussed in Section 2, the factor model we specified contains a group factor that the selected economies share together, such as common culture or a trade agreement. Table 5 and Table 6 show the regression estimates of the parameters of Eq. 2.1 with the Chinese culture and ASEAN agreement respectively. Since the first principal component is highly correlated with that from the Chinese culture group, which contains Mainland China, Hong Kong, Taiwan and Singapore, we have to use the residuals of an auxiliary regression of the Chinese culture factor on the first principal component to avoid the multi-collinearity problem. The parameters of the two independent variables are highly significant and the R^2 s are very high too (except the bilateral trade between Hong Kong and Taiwan). The results reflect the strong trade integration among these four economies. For the ASEAN group, which is composed of Indonesia, Malaysia, Philippines, Singapore and Thailand, the estimated parameters of the two independent variables, the common factor and the

auxiliary residuals from the regression of the ASEAN factor on the first principal component, again are significant and the R^2s are high too, except when a country is paired with Philippines. Perhaps, Philippines is not that highly trade integrated inside the ASEAN group.

--- Insert Table 5 here ---

--- Insert Table 6 here ---

The factor model, Eq. 2.2, is applied on the bilateral interest rate correlation series of the selected thirteen economies. Table 7 and Table 8 contain the estimated parameters of the Chinese culture group and the ASEAN group respectively. Some parameters of the first principal component, G_t, become insignificant when the group factor is present.

--- Insert Table 7 here ---

--- Insert Table 8 here ---

We combine the trade intensity series set and the interest rate series set together. Vietnam is dropped from the combined set because of its interest rate data limitation and the sample period is from January 2000 to December 2006. Table 9 describes the first five principal components. The first principal component accounts for only 26% of the total variation in the data set whereas the second principal component explains another 13% of the total variation. While Table 10 shows that the first principal component (i.e. W_t in Eq. 2.3 and Eq. 2.4) is still the strong signal in the trade intensity set, Table 11 reviews that this component is not much related to the interest rate correlation set.

--- Insert Table 9 here ---

--- Insert Table 10 here ---

--- Insert Table 11 here ---

We investigate the overall level of integration, the integration attributed to the common trade factor and the integration due to specific group factors in Table 12 and

Table 13. Since the three factors are interrelated, we utilize again the auxiliary regression to obtain the orthogonal residuals for the trade factor and the specific group factors, namely the Chinese culture and ASEAN trade agreement. The results are similar to those shown in Table 5 and Table 6, particularly the R^2s are very similar. That indicates the information of the overall integration factor is very limited in addition to that of the common trade factor and specific group factor.

--- Insert Table 12 here ---

--- Insert Table 13 here ---

Table 14 and Table 15 show the results of the overall common—financial factor—specific group factor models. Again, they show that the information added by the overall integration factor is very limited.

--- Insert Table 14 here ---

--- Insert Table 15 here ---

4. Conclusion

We investigate the trade and financial integration among the selected Asian economies. There is strong evidence that the degree of trade integration in the region is very high. Furthermore, specific group factors, such as common culture and trade agreement, are found to be significant in our factor models for trade integration. Nevertheless, the evidence for a high degree of financial integration cannot be identified in the interest rate correlation series set. These results match with the observations in recent years. On the one hand, with the rise of the Chinese and Indian economies, the inter-regional trade has grown significantly. On the other hand, there is no strong evidence that the trade integration has fostered a high degree of financial integration in the region. This may be due to the fact that the major economies in the region base their monetary policies on the needs of their domestic economies, in addition to the existence of different degree of capital controls.

The work in this paper is just the first step in the investigation of economic integration in the region. Further investigation of financial integration may need other pricing measures such as stock market returns in these economies or quantitative measures such as financial restrictiveness.[7] Another further research topic could be the investigation of change of integration over time. This needs to combine all the individual factor models into a big panel model and assume that the average effect of the integration is homogenous across the selected economies. With a suitable dynamic model of the integration, we can utilise the time-varying parameter regression, usually with Kalman filter, to estimate the dynamic property of the integration in order to gauge whether there is an increase in integration over time.

[7] See Mody and Murshid (2002).

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Table 1. Principal Component Analysis of Trade Intensity Series (1998M1 to 2006M12)

	First Principal Component	Second Principal Component	Third Principal Component	Fourth Principal Component	Fifth Principal Component
Eigenvalue	43.88	7.72	5.12	4.65	2.55
Variance Proportion	0.48	0.08	0.06	0.05	0.03
Cumulative Value	43.88	51.59	56.71	61.36	63.91
Cumulative Proportion	0.48	0.57	0.62	0.67	0.70

Table 2. Principal Component Analysis of Interest Rate Correlation Series (2000M1 to 2006M12)

	First Principal Component	Second Principal Component	Third Principal Component	Fourth Principal Component	Fifth Principal Component
Eigenvalue	15.72	11.00	8.87	7.52	6.18
Variance Proportion	0.20	0.14	0.11	0.10	0.08
Cumulative Value	15.72	26.72	35.59	43.10	49.29
Cumulative Proportion	0.20	0.34	0.46	0.55	0.63

Table 3. Variance Ratio of the First Principal Component of the Trade Intensity (1998M1 to 2006M12)

	China	India	Japan	Korea	Singapore	Malaysia	Thailand	Indonesia	Philippines	Taiwan	Hong Kong	Vietnam	Australia	New Zealand
China		13.12	6.48	15.30	15.43	24.45	14.62	27.82	24.55	11.62	57.79	31.42	11.47	45.27
India	86.88		56.93	28.66	20.13	69.14	27.95	8.75	92.78	35.57	56.48	8.92	33.63	86.47
Japan	93.52	43.07		26.71	44.18	53.15	7.52	15.93	40.75	26.39	15.01	12.89	24.41	25.85
Korea	84.70	71.34	73.29		99.54	90.98	91.81	100.00	63.61	32.07	72.56	57.64	97.00	94.25
Singapore	84.57	79.87	55.82	0.46		90.87	49.67	24.56	95.70	34.56	9.31	32.80	76.86	47.17
Malaysia	75.55	30.86	46.85	9.02	9.13		11.23	53.91	89.52	72.70	29.92	32.22	89.00	99.70
Thailand	85.38	72.05	92.48	8.19	50.33	88.77		47.48	75.12	44.16	11.26	17.30	31.89	50.70
Indonesia	72.18	91.25	84.07	0.00	75.44	46.09	52.52		99.29	58.52	82.26	89.45	97.49	88.91
Philippines	75.45	7.22	59.25	36.39	4.30	10.48	24.88	0.71		69.02	38.64	86.99	74.09	85.28
Taiwan	88.38	64.43	73.61	67.93	65.44	27.30	55.84	41.48	30.98		84.30	18.91	99.87	68.44
Hong Kong	42.21	43.52	84.99	27.44	90.69	70.08	88.74	17.74	61.36	15.70		20.40	70.38	92.48
Vietnam	68.58	91.08	87.11	42.36	67.20	67.78	82.70	10.55	13.01	81.09	79.60		54.31	99.59
Australia	88.53	66.37	75.59	3.00	23.14	11.00	68.11	2.51	25.91	0.13	29.62	45.69		99.07
New Zealand	54.73	13.53	74.15	5.75	52.83	0.30	49.30	11.09	14.72	31.56	7.52	0.41	0.93	
Mean	76.97	58.57	72.60	33.07	50.71	37.94	63.02	38.89	28.05	49.53	50.71	56.71	33.89	24.37

Model For Each Trading Pair:

$$TI_t = C + \hat{\gamma}\,\hat{F}_t + \hat{\varepsilon}_t$$

Below the diagonal:

$$\frac{\text{var}(\hat{\gamma}\,\hat{F}_t)}{\text{var}(TI_t)} * 100$$

Above the diagonal:

$$\frac{\text{var}(\hat{\varepsilon}_t)}{\text{var}(TI_t)} * 100$$

Notes: var are sample variance

Table 4. Variance Ratio of the First Principal Component of the Interest Rate Correlation (2000M1 to 2006M12)

	China	India	Japan	Korea	Singapore	Malaysia	Thailand	Indonesia	Philippines	Taiwan	Hong Kong	Australia	New Zealand
China		97.02	98.61	95.89	99.74	90.15	99.99	98.14	99.93	99.99	99.49	98.40	96.43
India	2.98		91.40	70.98	83.12	48.49	80.89	32.21	95.34	99.92	99.91	62.35	86.44
Japan	1.39	8.60		50.52	86.61	68.78	78.56	61.82	84.91	63.44	86.91	52.59	57.35
Korea	4.11	29.02	49.48		45.35	77.26	78.80	91.58	97.50	54.26	70.68	89.13	85.23
Singapore	0.26	16.88	13.39	54.65		59.76	96.01	83.45	69.71	75.93	98.01	78.05	80.58
Malaysia	9.85	51.51	31.22	22.74	40.24		54.57	99.20	99.89	36.22	55.36	80.80	57.35
Thailand	0.01	19.11	21.44	21.20	3.99	45.43		52.92	87.03	94.59	94.74	81.56	99.63
Indonesia	1.86	67.79	38.18	8.42	16.55	0.80	47.08		99.24	51.80	63.27	94.64	91.87
Philippines	0.07	4.66	15.09	2.50	30.29	0.11	12.97	0.76		79.07	71.03	84.72	78.72
Taiwan	0.01	0.08	36.56	45.74	24.07	63.78	5.41	48.20	20.93		94.70	64.99	78.83
Hong Kong	0.51	0.09	13.09	29.32	1.99	44.64	5.26	36.73	28.97	5.30		73.19	75.47
Australia	1.60	37.65	47.41	10.87	21.95	19.20	18.44	5.36	15.28	35.01	26.81		84.69
New Zealand	3.57	13.56	42.65	14.77	19.42	42.65	0.37	8.13	21.28	21.17	24.53	15.31	
Mean	2.19	21.00	26.54	24.40	20.31	31.01	16.73	23.32	12.74	25.52	18.10	21.24	18.95

Model For Each Interest Rate Correlation Pair:

$$IR_t = C + \hat{\gamma}\hat{G}_t + \hat{\varepsilon}_t$$

Below the diagonal:

$$\frac{\text{var}(\hat{\gamma}\hat{G}_t)}{\text{var}(IR_t)} * 100$$

Above the diagonal:

$$\frac{\text{var}(\hat{\varepsilon}_t)}{\text{var}(IR_t)} * 100$$

Notes: var are sample variance

Table 5. Estimation Result of Regressing Trade Intensity Series on their First Principal Component and the Chinese Culture Factor (1998M1 to 2006M12)

	China vs Singapore	China vs Taiwan	China vs Hong Kong	Singapore vs Taiwan	Singapore vs Hong Kong	Taiwan vs Hong Kong
Constant	1.14 (0.00)	1.37 (0.00)	9.48 (0.00)	2.22 (0.00)	7.15 (0.00)	6.84 (0.00)
First Principal Component (F_t)	0.06 (0.00)	0.13 (0.00)	0.21 (0.00)	0.06 (0.00)	0.27 (0.00)	0.05 (0.00)
U_t	0.18 (0.00)	0.21 (0.00)	2.26 (0.00)	0.14 (0.01)	-0.01 (0.93)	0.56 (0.00)
R^2	0.89	0.90	0.71	0.68	0.91	0.27
$Adj.R^2$	0.89	0.90	0.70	0.67	0.91	0.26
DW	1.17	0.70	1.05	0.71	0.79	1.11

Note: U_t is the residual of an auxiliary regression of the Chinese Culture Factor on the First Principal Component of the Trading Intensity Series.
( ) contains the p-value of the t-test of the estimated parameter.

Table 6. Estimation Result of Regressing Trade Intensity Series on their First Principal Component and the ASEAN 5 Factor (1998M1 to 2006M12)

	Singapore vs Malaysia	Singapore vs Thailand	Singapore vs Indonesia	Singapore vs Philippines	Malaysia vs Thailand	Malaysia vs Indonesia	Malaysia vs Philippines	Thailand vs Indonesia	Thailand vs Philippines	Indonesia vs Philippines
Constant	20.73 (0.00)	5.31 (0.00)	5.16 (0.00)	3.35 (0.00)	3.30 (0.00)	1.42 (0.00)	1.82 (0.00)	0.98 (0.00)	1.13 (0.00)	0.41 (0.00)
First Principal Component (F_t)	0.09 (0.00)	0.06 (0.00)	0.25 (0.00)	0.01 (0.01)	0.11 (0.00)	0.02 (0.00)	0.01 (0.00)	0.03 (0.00)	0.02 (0.00)	-0.001 (0.34)
U_t	1.45 (0.00)	0.29 (0.00)	0.02 (0.82)	0.23 (0.00)	0.12 (0.00)	0.09 (0.00)	0.08 (0.00)	0.06 (0.00)	0.08 (0.00)	0.04 (0.00)
R^2	0.58	0.73	0.75	0.27	0.91	0.61	0.18	0.57	0.37	0.17
$Adj.R^2$	0.57	0.73	0.75	0.26	0.91	0.60	0.16	0.56	0.36	0.16
DW	0.99	1.11	0.39	1.11	1.28	1.25	0.77	0.75	0.49	1.14

Note: U_t is the residual of an auxiliary regression of the ASEAN 5 Factor on the First Principal Component of the Trading Intensity Series.

( ) contains the p-value of the t-test of the estimated parameter.

Table 7. Estimation Result of Regressing Interest Rate Correlation Series on their First Principal Component and the Chinese Culture Factor (2000M1 to 2006M12)

	China vs Singapore	China vs Taiwan	China vs Hong Kong	Singapore vs Taiwan	Singapore vs Hong Kong	Taiwan vs Hong Kong
Constant	0.04 (0.16)	-0.02 (0.65)	-0.14 (0.00)	0.54 (0.00)	0.56 (0.00)	0.62 (0.00)
First Principal Component (G_t)	-0.01 (0.40)	-0.001 (0.87)	-0.01 (0.46)	0.05 (0.00)	0.01 (0.11)	0.02 (0.01)
U_t	0.23 (0.00)	0.26 (0.00)	0.16 (0.00)	-0.13 (0.00)	-0.12 (0.00)	-0.14 (0.00)
R^2	0.70	0.59	0.27	0.52	0.39	0.44
$Adj.R^2$	0.70	0.58	0.25	0.51	0.37	0.43
DW	0.36	0.20	0.18	0.23	0.30	0.30

Note: U_t is the residual of an auxiliary regression of the Chinese Culture Factor on the First Principal Component of the Interest Rate Correlation Series.
( ) contains the p-value of the t-test of the estimated parameter.

Table 8. Estimation Result of Regressing Interest Rate Correlation Series on their First Principal Component and the ASEAN 5 Factor (2000M1 to 2006M12)

	Singapore vs Malaysia	Singapore vs Thailand	Singapore vs Indonesia	Singapore vs Philippines	Malaysia vs Thailand	Malaysia vs Indonesia	Malaysia vs Philippines	Thailand vs Indonesia	Thailand vs Philippines	Indonesia vs Philippines
Constant	0.12 (0.00)	0.40 (0.00)	-0.004 (0.92)	-0.08 (0.02)	0.11 (0.00)	0.04 (0.46)	0.39 (0.00)	0.32 (0.00)	0.19 (0.00)	0.14 (0.00)
First Principal Component (G_t)	0.09 (0.00)	0.02 (0.07)	-0.04 (0.00)	0.07 (0.00)	0.10 (0.00)	-0.01 (0.28)	-0.003 (0.77)	-0.08 (0.00)	0.05 (0.00)	-0.01 (0.14)
U_t	0.17 (0.00)	-0.01 (0.67)	0.06 (0.03)	0.18 (0.00)	0.23 (0.00)	0.26 (0.00)	0.04 (0.15)	0.06 (0.01)	0.25 (0.00)	0.23 (0.00)
R^2	0.63	0.04	0.21	0.64	0.82	0.46	0.03	0.51	0.75	0.73
$Adj.R^2$	0.62	0.02	0.19	0.63	0.82	0.44	0.002	0.50	0.75	0.72
DW	0.18	0.13	0.25	0.17	0.28	0.16	0.21	0.26	0.23	0.48

Note: U_t is the residual of an auxiliary regression of the ASEAN 5 Factor on the First Principal Component of the Interest Rate Correlation Series.

( ) contains the p-value of the t-test of the estimated parameter.

Table 9. Principal Component Analysis of Trade Intensity and Interest Rate Correlation Series (2000M1 to 2006M12)

	First Principal Component	Second Principal Component	Third Principal Component	Fourth Principal Component	Fifth Principal Component
Eigenvalue	40.02	20.05	12.70	10.79	9.51
Variance Proportion	0.26	0.13	0.08	0.07	0.06
Cumulative Value	40.02	60.07	72.77	83.56	93.06
Cumulative Proportion	0.26	0.39	0.47	0.54	0.60

Table 10. Variance Ratio of W_t to the Trade Intensity Series (2000M1 to 2006M12)

	China	India	Japan	Korea	Singapore	Malaysia	Thailand	Indonesia	Philippines	Taiwan	Hong Kong	Australia	New Zealand
China		15.92	7.73	19.87	18.22	35.85	20.45	41.37	22.05	9.31	60.13	17.47	57.56
India	84.08		47.99	14.03	21.48	41.93	43.64	9.09	99.99	42.55	64.94	25.64	72.20
Japan	92.27	52.01		28.44	60.44	87.82	10.35	31.40	62.31	38.43	18.31	26.09	20.04
Korea	80.13	85.97	71.56		92.73	99.72	97.87	95.74	69.91	48.49	73.18	94.26	98.20
Singapore	81.78	78.52	39.56	7.27		99.97	74.61	12.25	99.50	57.75	11.20	91.40	42.84
Malaysia	64.15	58.07	12.18	0.28	0.03		17.08	57.60	86.97	93.63	39.97	97.86	98.37
Thailand	79.55	56.36	89.65	2.13	25.39	82.92		41.34	99.98	58.27	19.14	53.63	71.65
Indonesia	58.63	90.91	68.60	4.26	87.75	42.40	58.66		99.79	71.58	90.55	87.69	98.67
Philippines	77.95	0.01	37.69	30.09	0.50	13.03	0.02	0.21		97.52	47.77	60.08	99.57
Taiwan	90.69	57.45	61.57	51.51	42.25	6.37	41.73	28.42	2.48		99.52	99.97	69.83
Hong Kong	39.87	35.06	81.69	26.82	88.80	60.03	80.86	9.45	52.23	0.48		62.13	95.69
Australia	82.53	74.36	73.91	5.74	8.60	2.14	46.37	12.31	39.92	0.03	37.87		95.94
New Zealand	42.44	27.80	79.96	1.80	57.16	1.63	28.35	1.33	0.43	30.17	4.31	4.06	
Mean	72.84	58.38	63.39	30.63	43.13	28.60	49.33	38.58	21.21	34.43	43.12	32.32	23.29

Model For Each Trading Pair:

$$TI_t = C + \hat{\beta}\hat{W}_t + \hat{\nu}_t$$

Below the diagonal:

$$\frac{\text{var}(\hat{\beta}\hat{W}_t)}{\text{var}(TI_t)} * 100$$

Above the diagonal:

$$\frac{\text{var}(\hat{\nu}_t)}{\text{var}(TI_t)} * 100$$

Note: var are sample variance

Table 11. Variance Ratio of W_t to the Interest Rate Correlation Series (2000M1 to 2006M12)

	China	India	Japan	Korea	Singapore	Malaysia	Thailand	Indonesia	Philippines	Taiwan	Hong Kong	Australia	New Zealand
China		96.45	62.91	81.68	99.92	98.50	93.21	55.47	94.17	99.72	89.69	83.84	90.31
India	3.55		96.91	99.79	88.93	97.49	71.62	87.29	79.06	98.68	99.55	92.95	95.37
Japan	37.09	3.09		99.96	90.07	99.99	99.08	99.98	76.90	99.77	99.41	98.97	99.99
Korea	18.32	0.21	0.04		87.69	98.77	99.79	90.63	99.33	94.74	92.87	63.49	83.64
Singapore	0.08	11.07	9.93	12.31		99.98	77.67	78.96	75.92	98.47	98.29	85.90	98.80
Malaysia	1.50	2.51	0.01	1.23	0.02		99.34	99.95	89.15	99.62	97.99	99.26	99.54
Thailand	6.79	28.38	0.92	0.21	22.33	0.66		96.04	84.88	59.79	64.91	99.27	53.83
Indonesia	44.53	12.71	0.02	9.37	21.04	0.05	3.96		100.00	88.21	57.69	99.68	76.48
Philippines	5.83	20.94	23.10	0.67	24.08	10.85	15.12	0.00		92.87	99.75	88.54	98.92
Taiwan	0.28	1.32	0.23	5.26	1.53	0.38	40.21	11.79	7.13		98.51	97.81	94.72
Hong Kong	10.31	0.45	0.59	7.13	1.71	2.01	35.09	42.31	0.25	1.49		91.58	100.00
Australia	16.16	7.05	1.03	36.51	14.10	0.74	0.73	0.32	11.46	2.19	8.42		63.05
New Zealand	9.69	4.63	0.01	16.36	1.20	0.46	46.17	23.52	1.08	5.28	0.00	36.95	
Mean	12.84	7.99	6.34	8.97	9.95	1.70	16.71	14.14	10.04	6.42	9.15	11.30	12.11

Model For Each Interest Rate Correlation Pair:

$$IR_t = C + \hat{\beta}\hat{W}_t + \hat{\varepsilon}_t$$

Below the diagonal:

$$\frac{\text{var}(\hat{\beta}\hat{W}_t)}{\text{var}(IR_t)} * 100$$

Above the diagonal:

$$\frac{\text{var}(\hat{\varepsilon}_t)}{\text{var}(IR_t)} * 100$$

Note: var are sample variance

Table 12. Estimation Result of Regressing Trade Intensity Series on W_t, their First Principal Component and the Chinese Culture Factor (2000M1 to 2006M12)

	China vs Singapore	China vs Taiwan	China vs Hong Kong	Singapore vs Taiwan	Singapore vs Hong Kong	Taiwan vs Hong Kong
Constant	1.24 (0.00)	1.64 (0.00)	9.81 (0.00)	2.37 (0.00)	7.68 (0.00)	7.03 (0.00)
Overall Common Factor (W_t)	0.06 (0.00)	0.12 (0.00)	0.21 (0.00)	0.04 (0.00)	0.27 (0.00)	0.01 (0.48)
U_t	0.08 (0.00)	-0.07 (0.00)	0.58 (0.00)	0.15 (0.00)	0.21 (0.00)	0.34 (0.00)
ξ_t	0.21 (0.00)	0.35 (0.00)	2.21 (0.00)	0.12 (0.07)	-0.17 (0.22)	0.37 (0.02)
R^2	0.91	0.95	0.74	0.56	0.90	0.26
$Adj.R^2$	0.91	0.95	0.73	0.55	0.90	0.23
DW	1.32	0.94	0.93	0.84	0.95	1.35

Note: U_t is the residual of an auxiliary regression of the first principal component of trade intensity on the overall common factor.

ξ_t is the residual of an auxiliary regression of the Chinese Culture Factor from the TI Series on the overall common factor and U_t.

( ) contains the p-value of the t-test of the estimated parameter.

Table 13. Estimation Result of Regressing Trade Intensity Series on W_t, their First Principal Component and the ASEAN 5 Factor (2000M1 to 2006M12)

	Singapore vs Malaysia	Singapore vs Thailand	Singapore vs Indonesia	Singapore vs Philippines	Malaysia vs Thailand	Malaysia vs Indonesia	Malaysia vs Philippines	Thailand vs Indonesia	Thailand vs Philippines	Indonesia vs Philippines
Constant	21.06 (0.00)	5.47 (0.00)	5.53 (0.00)	3.42 (0.00)	3.58 (0.00)	1.46 (0.00)	1.84 (0.00)	1.04 (0.00)	1.22 (0.00)	0.40 (0.00)
Overall Common Factor (W_t)	-0.00 (0.78)	0.04 (0.00)	0.29 (0.00)	-0.01 (0.48)	0.09 (0.00)	0.02 (0.00)	0.02 (0.00)	0.03 (0.00)	0.00 (0.89)	0.00 (0.62)
U_t	1.23 (0.00)	0.24 (0.00)	-0.14 (0.06)	0.18 (0.00)	0.02 (0.40)	0.08 (0.00)	-0.02 (0.59)	-0.02 (0.26)	0.04 (0.01)	-0.00 (0.90)
ξ_t	1.02 (0.00)	0.23 (0.00)	0.25 (0.00)	0.12 (0.02)	0.17 (0.00)	0.09 (0.00)	0.08 (0.00)	0.09 (0.00)	0.03 (0.05)	0.05 (0.00)
R^2	0.72	0.69	0.90	0.20	0.91	0.72	0.22	0.72	0.11	0.33
$Adj.R^2$	0.71	0.68	0.89	0.17	0.90	0.71	0.19	0.71	0.08	0.30
DW	1.17	1.36	0.74	1.26	1.61	1.47	0.77	1.09	0.71	1.53

Note: U_t is the residual of an auxiliary regression of the first principal component of trade intensity on the overall common factor.

ξ_t is the residual of an auxiliary regression of the ASEAN 5 Factor from the TI Series on the overall common factor and U_t.

( ) contains the p-value of the t-test of the estimated parameter.

Table 14. Estimation Result of Regressing Interest Rate Correlation Series on W_t, their First Principal Component and the Chinese Culture Factor (2000M1 to 2006M12)

	China vs Singapore	China vs Taiwan	China vs Hong Kong	Singapore vs Taiwan	Singapore vs Hong Kong	Taiwan vs Hong Kong
Constant	0.04 (0.16)	-0.02 (0.66)	-0.14 (0.00)	0.54 (0.00)	0.56 (0.00)	0.62 (0.00)
Overall Common Factor (W_t)	-0.00 (0.65)	-0.00 (0.46)	-0.02 (0.00)	0.01 (0.10)	-0.01 (0.13)	-0.01 (0.14)
U_t	-0.01 (0.32)	-0.00 (0.71)	-0.02 (0.08)	0.06 (0.00)	0.01 (0.20)	0.02 (0.01)
ξ_t	0.23 (0.00)	0.27 (0.00)	0.15 (0.00)	-0.13 (0.00)	-0.13 (0.00)	-0.14 (0.00)
R^2	0.71	0.59	0.35	0.56	0.41	0.46
$Adj.R^2$	0.70	0.58	0.33	0.54	0.39	0.44
DW	0.37	0.20	0.24	0.27	0.33	0.32

Note: U_t is the residual of an auxiliary regression of the first principal component of the interest rate correlation series on the overall common factor.

ξ_t is the residual of an auxiliary regression of the Chinese Culture Factor from the IR Series on the overall common factor and U_t.

( ) contains the p-value of the t-test of the estimated parameter.

Table 15. Estimation Result of Regressing Interest Rate Correlation Series on W_t, their First Principal Component and the ASEAN 5 Factor (2000M1 to 2006M12)

	Singapore vs Malaysia	Singapore vs Thailand	Singapore vs Indonesia	Singapore vs Philippines	Malaysia vs Thailand	Malaysia vs Indonesia	Malaysia vs Philippines	Thailand vs Indonesia	Thailand vs Philippines	Indonesia vs Philippines
Constant	0.12 (0.00)	0.40 (0.00)	-0.00 (0.92)	-0.08 (0.01)	0.11 (0.00)	0.04 (0.46)	0.39 (0.00)	0.32 (0.00)	0.19 (0.00)	0.14 (0.00)
Overall Common Factor (W_t)	0.00 (0.82)	0.04 (0.00)	0.03 (0.00)	-0.04 (0.00)	0.01 (0.01)	0.00 (0.79)	-0.02 (0.00)	0.01 (0.01)	-0.03 (0.00)	0.00 (0.94)
U_t	0.09 (0.00)	0.04 (0.00)	-0.03 (0.00)	0.06 (0.00)	0.11 (0.00)	-0.01 (0.30)	-0.01 (0.25)	-0.08 (0.00)	0.04 (0.00)	-0.01 (0.13)
ξ_t	0.17 (0.00)	-0.00 (0.95)	0.07 (0.01)	0.17 (0.00)	0.24 (0.00)	0.26 (0.00)	0.03 (0.20)	0.06 (0.01)	0.25 (0.00)	0.23 (0.00)
R^2	0.68	0.33	0.34	0.74	0.92	0.46	0.14	0.51	0.81	0.73
$Adj.R^2$	0.66	0.31	0.34	0.73	0.91	0.44	0.11	0.49	0.81	0.72
DW	0.24	0.24	0.34	0.26	0.68	0.16	0.26	0.26	0.36	0.48

Note: U_t is the residual of an auxiliary regression of the first principal component of interest rate correlation series on the overall common factor.

ξ_t is the residual of an auxiliary regression of the ASEAN 5 Factor from the IR Series on the overall common factor and U_t.

( ) contains the p-value of the t-test of the estimated parameter.

Figure 1. Selected Trade Intensity Series (1998M1 to 2006M12)

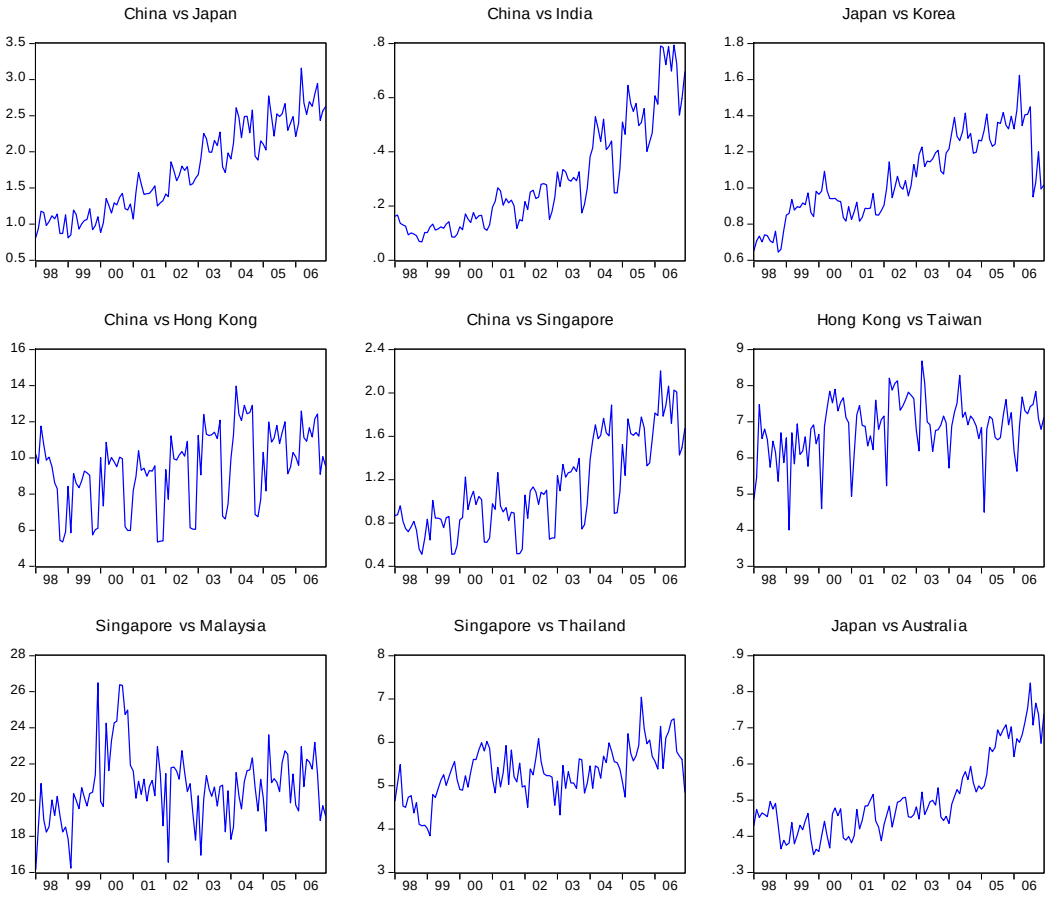

Figure 2. Selected Interest Rate Correlation Series (2000M1 to 2006M12)