Part 3: Chapter 7 - Trade and Business Cycle Correlation in the Asia-Pacific Region

Chapter 7

Trade and Business Cycle Correlation in the Asia-Pacific Region

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Introduction

The Asian financial crisis in 1997 and the European monetary unification in 1999 have spurred interest in monetary policy coordination in East Asia. Although the theory of optimum currency areas (OCA) argues against monetary unification by countries with asynchronous business cycles, recent studies pioneered by Frankel and Rose (1998, hereafter F&R 1998) contend that the very act of forming a monetary union boosts trade among member countries and helps eliminate incongruities in their business cycles. If such effects are sufficiently strong, like-minded countries that do not constitute an OCA *ex ante* can transform themselves into one *ex post*, rendering traditional OCA criteria all but irrelevant.

This chapter examines the relationship between trade and international business cycle correlations for a subset of Asia-Pacific economies, with an eye to shedding light on the potential endogeneity of the OCA criteria. Although we follow F&R's empirical approach, we also pay close attention to several salient characteristics of the East Asian economies, including their export structures that are concentrated in a relatively limited range of products, growing international production sharing, and sensitivity to cross-border capital flows. While our results confirm the role of trade as a channel for the international transmission of economic shocks, we find that the primary determinant of cross-country business-cycle co-movements is the industrial and export specialization of individual countries, particularly the extent to which their economies depend on the electronics industry. Moreover, as trade and industrial structure account for relatively small portions of cross-country income correlations, East Asian policy makers would be wise to think carefully before venturing into an ambitious regional currency arrangement.

1. Literature

Although the effect of monetary unification on international business-cycle correlations is a dynamic issue, Rose (2000) and F&R (1998) assessed its quantitative importance in terms of two sets of cross-sectional regressions. First, Rose (2000) estimates a variant of the gravity model of international trade for a wide cross-section of countries, finding that countries sharing a common currency on average trade much more extensively than those with different legal tenders. Second, F&R (1998) estimate the relationship between cross-country business-cycle correlations and trade using the following model:

(1) $$\rho(i,j) = \alpha + \beta T(i,j) + \sum_k \gamma_k Z_k(i,j) + \varepsilon(i,j)$$

where $\rho(i,j)$ refers to the extent of business-cycle correlation between countries *i* and *j*, $T(i,j)$ is the intensity of the bilateral trade between these countries, $Z_k(i,j)$, $k = 1,2,\ldots$ are other relevant variables, and $\varepsilon(i,j)$ is the error term. Whilst F&R's sample includes only OECD countries, they find positive and statistically significant values for β under a variety of specifications. Putting these results together, Rose (2000) argues that the net welfare effect of monetary union is much more favorable than commonly believed.

Although several studies have subsequently applied F&R's (1998) method to East Asian countries, their results tend to be less clear-cut. For example, Crosby (2003) constructs variables that presumably represent the gap in industrial sophistication between countries *i* and *j*, and reports that the positive relationship between $T(i,j)$ and $\rho(i,j)$ disappears once these variables are included on the right hand side (RHS) of eq. (1). Similarly, Shin and Wang (2004) add a variable measuring the share of intra-industry trade (IIT) between countries *i* and *j* and argue that international trade strengthens business-cycle correlations only when it is composed mainly of IIT. In Choe's (2001) study, a dummy variable representing membership in the Association of Southeast Asian Nations (ASEAN) is found to be highly significant, which the author attributes to long-standing corporation among ASEAN countries.

To motivate our subsequent investigation, the remainder of this section discusses three issues that potentially complicate F&R's empirical model but have hitherto received little attention. As we shall see below, paying proper attention to these issues takes us some way toward providing a coherent account of what is behind the seemingly disparate results of the existing studies.

First, although the existing studies construct the trade intensity variable $T(i,j)$ in terms of the *gross* value of *bilateral* trade, doing so makes the meaning of its coefficient difficult to ascertain. For example, Malaysia and Singapore trade heavily with each other but also export substantial amounts of goods to third countries such as the United States. As the trade structure of a country is generally *multilateral*, an empirical model that includes only a variable measuring *bilateral* trade intensity may suffer from a potentially serious bias.

Second, although intra-regional trade in Asia has grown substantially in the recent past, a sizable part of this trade concerns not final consumer goods but parts and components of manufactures, particularly electrical and electronic products. This raises two issues. First, to the extent that some goods cross national borders more than once (first as an intermediate good and second as either a part of a finished product or a more advanced intermediate input), a trade variable based on gross bilateral trade volume becomes an even less reliable measure of the interdependence between two economies. Second, as substantial portions of East Asia's trade in intermediate goods involve electronic products, and as the world's electronics industry is known to be subject to considerable cyclical fluctuations, *both* the bilateral trade variable *and* the IIT variable can confound the effect of industry shocks on national business cycles with that of international trade.

The third and more technical issue is the merit of estimating eq. (1) using the instrumental variable (IV) method. According to F&R (1998), $T(i,j)$ and the dependent variable are endogenous because countries tend to stabilize their currencies to those of their most important trading partners, an operation that effectively synchronizes their monetary policies and presumably their business cycles as well. However, although OLS should bias the estimate of β upward under such circumstances, in F&R's work most OLS estimates of β were substantially smaller than the corresponding IV estimates. This observation suggests that the original regression model omits an important variable that is correlated positively with the IVs. For East Asian countries, these missing variables may include international capital movement. To the extent that international financial flows are spatially correlated, the empirical correlation of capital movements into and out of individual countries is unlikely to be independent of IVs typically employed in the existing studies, such as their geographical proximity.

2. Variables construction

Our sample is the following 13 countries in the greater Asia-Pacific region: Australia, China, India, Indonesia, Japan, Korea, Malaysia, New Zealand, the Philippines, Singapore, Taiwan, Thailand and the United States. With 13 countries, there are 13×12÷2 = 78 country combinations. We measure the regressand $\rho(i,j)$ using annual real GDP data for 1984-2003[1]. We consider two alternative formulas for $\rho(i,j)$. Let $y_t(i)$ denote the natural logarithm of country i's real GDP in year t and let $\Delta y_t(i) = y_t(i) - y_{t-1}(i)$. Our first measure of $\rho(i,j)$ is simply:

(2) $$\rho_1(i,j) \equiv corr(\Delta y_t(i), \Delta y_t(j))$$

where $corr(.,.)$ denotes the correlation coefficient. This index can understate the interdependency of the two countries if one country's business cycle affects the other's with a substantial time lag. To allow for this possibility, let us consider the following measure as well:

(3) $$\rho_2(i,j) \equiv 2/3 \times \rho_1(i,j) + 1/3 \times \max\begin{bmatrix} corr(\Delta y_t(i), \Delta y_{t-1}(j)), \\ corr(\Delta y_{t-1}(i), \Delta y_t(j)) \end{bmatrix}$$

Both $\rho_1(i,j)$ and $\rho_2(i,j)$ are computed excluding data for 1998 in order to alleviate the effect of the Asian crisis.

Table 1 of the Japanese text presents the computed values of $\rho_1(i,j)$ and $\rho_2(i,j)$ for our 78 country pairs. The business cycles of four Southeast Asian countries (Indonesia, Malaysia, Singapore and Thailand) are tightly correlated, with the values for the Malaysia-Singapore pair particularly high. Slightly milder correlations are also found for three industrial countries (Australia, New Zealand and the United States) and three Northeast Asian countries (Japan, Korea and Taiwan).

We develop $T(i,j)$ in the following manner. Let $X_k^l(i,m)$ denote the exports of good k from country i to m. l signifies the industry in which this good is produced. We classify all goods k = 1, 2, .. into two sets – one composed entirely of finished products and the other made up of raw materials and intermediate goods – and let A denote the former set. Using these notations, let us adjust each $X_k^l(i,m)$, k = 1, 2, .. according to the following scheme:

(4) $$\widetilde{X}_k(i,m) \equiv \begin{cases} \delta^l(i) X_k^l(i,m) & \text{if } k \in A \\ \sum_{j \neq i} \theta^l(j,m) X_k^l(i,j) & \text{if } k \notin A \end{cases}$$

(5) $$\delta^l(i) \equiv \frac{O^l(i) - \sum_{j \neq i} \sum_{k \notin A} X_k^l(j,i)}{O^l(i)}, \quad \theta^l(j,m) \equiv \frac{X^l(j,m)}{O^l(j)},$$

where $O^i(l)$ is the total output of industry l in country i. The first line of eq. (4) removes the value of imported production inputs from the export value of finished goods; the second line adjusts the export destination for raw materials and intermediate goods according to where the final goods embodying these production inputs are consumed. See the Appendix to the Japanese chapter for how these adjustments can be accomplished.

By computing $\tilde{X}(i,m) = \sum_k \tilde{X}_k(i,m)$, we can obtain a rough idea about the degree to which country i's value added depends directly or indirectly on the final demand coming from country m. Using this notation, let us define $T(i,j)$ as:

$$(6) \qquad T(i,j) \equiv \sum_m \min\left[\frac{\tilde{X}(i,m)}{Y(i)}, \frac{\tilde{X}(j,m)}{Y(j)}\right],$$

where $Y(i)$ denotes country i's nominal GDP and m = 1, 2, ... include i and j. Under normal circumstances, the RHS of eq. (6) can be divided into the following two components:

$$(7) \qquad \begin{aligned} T(i,j) &\equiv \left(\frac{\tilde{X}(i,j)}{Y(i)} + \frac{\tilde{X}(j,i)}{Y(j)}\right) \\ &\quad + \sum_{m \neq i,j} \min\left[\frac{\tilde{X}(i,m)}{Y(i)}, \frac{\tilde{X}(j,m)}{Y(j)}\right] \\ &\equiv T_1(i,j) + T_2(i,j). \end{aligned}$$

of which $T_1(i,j)$ and $T_2(i,j)$ reflect, respectively, the two countries' bilateral trade intensity and joint dependence on third-country export markets. As is shown in Figure 1 of the Japanese text, for the majority of country pairs $T_2(i,j)$ is substantially larger than $T_1(i,j)$, attesting to the importance of multilateral trade. In addition, the values of $T(i,j)$, $T_1(i,j)$ and $T_2(i,j)$ for the Malaysia-Singapore pair are all very large and constitute a near-outlier among the 78 samples. To prevent these countries from becoming a leverage point, we add a dummy variable for the Malaysia-Singapore combination to all subsequent regressions.

The existing studies suggest that the commodity profiles of exports between two countries are relevant to the correlation of their business cycles. Let us therefore write $\tilde{X}_k(i) \equiv \sum_{m \neq i} \tilde{X}_k(i,m)$ and define the following value:

$$(8) \qquad \omega(i,j) \equiv \sum_k \min\left[\frac{\tilde{X}_k(i)}{\sum_k \tilde{X}_k(i)}, \frac{\tilde{X}_k(j)}{\sum_k \tilde{X}(j)}\right]$$

This value reflects the similarity of export products between countries i and j and permits us, for example, to write $T(i,j)$ as the sum of $\omega(i,j)T(i,j)$ and $(1-\omega(i,j))T(i,j)$.

Our final task is to decide how to control for the potential impact of international capital flows on national business cycles. We first define $ci_t(i)$ as the ratio of country i's net private capital inflow during year t to its nominal GDP in the preceding year. We then compute the correlation between $\{ci_t(i)\}_t$ and $\{ci_t(j)\}_t$ for 1984-2003, again excluding 1998:

$$(9) \qquad \nu(i,j) \equiv corr(ci_t(i), ci_t(j))$$

This variable is, however, almost certainly endogenous to the dependent variable[2]. This issue will be addressed by estimating eq. (1) using both OLS and IV methods, with IVs employed only for $\nu(i,j)$ in the latter estimation. See the Japanese text for how we chose IVs.

3. Estimation results

Tables 2 and 4 in the Japanese text present the results of our first set of regressions. In the OLS estimations of Table 2, the coefficient of $\nu(i,j)$ is of the expected sign and is highly statistically significant whereas this is generally not the case in the IV regressions of Table 4. Although the estimates in Table 2 are likely biased upward due to the endogeneity of $\nu(i,j)$ and the regressands, the standard errors of this coefficient in Table 4 may also be inflated by the relatively loose correlations between $\nu(i,j)$ and our IVs. In both equations, the estimated coefficients of our trade variables,

$T(i,j)$, $T_1(i,j)$ and $T_2(i,j)$, are positive but only marginally significant. Nevertheless, when $T(i,j)$ is broken down into $\omega(i,j)T(i,j)$ and $(1-\omega(i,j))T(i,j)$, the coefficient of the former variable turns out to be highly significant, whereas that of the latter is insignificant and of the wrong sign. If we split the former variable further into $\omega(i,j)T_1(i,j)$ and $\omega(i,j)T_2(i,j)$, we find that both of these variables are significant in the OLS estimation while only the latter remains so in the IV estimation.

The foregoing results indicate that similarities in the export products of two countries are important for their business cycle correlations, confirming the results of the previous studies. One issue that has *not* been addressed by these studies is whether this observation is only true in a specific industry, or if it is a general feature that encompasses the whole tradable goods sector. To investigate this question, we define the following variable:

(10)

$$\omega^l(i,j) \equiv \sum_{k \in l} \min\left[\frac{\widetilde{X}_k(i)}{\sum_h \widetilde{X}_h(i)}, \frac{\widetilde{X}_k(j)}{\sum_h \widetilde{X}_h(j)}\right]$$

where l denotes a specific industry, and consider dividing $\omega(i,j)T(i,j)$ further into $\omega^l(i,j)T(i,j)$ and $(\omega(i,j)-\omega^l(i,j))T(i,j)$. Among the countries for which Table 1 indicates strong GDP co-movements, Australia, New Zealand and the United States depend relatively heavily on agricultural and processed food products whereas the exports of some East Asian countries are concentrated in electronics. We thus consider two cases of l = 1 = agricultural, food and beverages industries and l = 2 = the electronics industry.

As shown in Table 5, the previous result turns out to be highly industry-specific: dependence on the agricultural and related industries is not relevant whereas specialization the electronics industry exhibits a significant explanatory power for international business cycle correlations. The importance of the electronics sector is further corroborated in Tables 6 and 7, where we include variables representing the minimum of the GDP shares of the electronics industry in countries *i* and *j* and correlations in their net service exports and income receipts from abroad. The tables show that the latter variable has the expected sign but is never significant statistically whereas the former is highly significant and numerically large. We also find that when a variable representing the joint dependence of the two countries on the electronics industry is included in eq. (1), our trade intensity variables are generally not significant and add little to the model's explanatory power.

The preceding results provide us with insight into what lies behind the findings of the existing studies. For example, Crosby's (2003) variables for bilateral differences in industrial structure and technological sophistication are closely related with our variables measuring two countries' joint dependence on the electronics sector. Similarly, the dummy variable for ASEAN membership included in Choe's (2001) estimation is naturally correlated with our electronics variables, as the ASEAN includes a few highly open economies that depend particularly heavily on the electronics industry. Lastly, Shin and Wang's (2004) IIT variable is also strongly correlated with our electronics variable since, as we noted in Section 2, the electronics sector is characterized by unusually extensive international sharing of production processes. When used in conjunction with our electronics variables, none of the above variables is in fact statistically significant. The last part of Section 4 in the Japanese text provides an additional analysis of why shocks associated with the electrics sector are so important in the business cycles of (a subset of) the Asia-Pacific economies, and how and to what extent the cyclical fluctuations in world electronics activities are related to the business cycles of major industrial economies such as the United States.

Conclusions

Although some recent studies argue that the traditional OCA criteria are endogenous to the decision to form a monetary union, the results summarized in the preceding section suggest that this is not necessarily the case for the Asia-Pacific economies. At least among a subset of our sample countries, specialization in the electronics industry is more relevant than trade intensity to international GDP correlations, suggesting that the effect of currency union stressed by F&R (1998) is contingent on how it influences the evolution of the industrial structure of member countries. Notice also that our estimation leaves substantial parts of cross-country business-cycle variations unaccounted for, pointing to the importance of other (potentially country-specific) factors.

Our results also suggest that the past business-cycle correlations among individual Asia-Pacific economies are an unreliable guide for their future relationship. For example, as the main engine of the global demand for electronics shifts from volatile corporate IT investment to household consumption, and as the industry becomes more mature and more closely connected with other industries, shocks unique to this sector may become less pronounced. In recent years, moreover, the center of electronics assembly operations has been shifting rapidly from Southeast Asia to China, with producers in advanced countries also competing vigorously to develop new products and grab market share. Finally, if the income levels of the East Asian economies continue to rise as rapidly as in the past, these countries will become more important end markets for electronics products, potentially amplifying the relationship between their business cycles and fluctuations of the international electronics market.

Notes

1 The Appendix to the Japanese text of this chapter provides an additional analysis based on quarterly GDP data.

2 Accelerated capital inflows presumably stimulate a country's economic activity, and a booming economy and a consequent increase in the interest rate may further stimulate inward investment. The endogeneity of $\Delta y_t(i)$ to $ci_t(t)$ has been confirmed by the standard Granger test for several countries.

References

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