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SYNCHRONIZED BUSINESS CYCLES IN EAST ASIA AND FLUCTUATIONS IN THE YEN/DOLLAR EXCHANGE RATE

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Synchronized Business Cycles in East Asia and Fluctuations in the Yen/Dollar Exchange Rate

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Abstract

Because many authors have proposed stimulating the ailing Japanese economy by monetary expansion and yen depreciation, we explore the repercussions of depreciating the yen against the dollar on the other East Asian economies—which largely peg to the dollar. Since 1980, economic integration among Japan's neighbors—China, Hong Kong, Indonesia, Korea, Malaysia, Philippines, Singapore, and Thailand—has intensified and (except for China) their business cycles have been highly synchronized. These cycles have been closely linked to fluctuations in the yen/dollar exchange rate—through changes in their export competitiveness and inflows of foreign direct investment. We show that a major yen devaluation would have a negative impact on incomes in other East Asian economies and that it is not a sensible policy option for Japan.

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1. Introduction

Should the Japanese yen be depreciated to revive the Japanese economy? Since the burst of the so-called bubble in December 1989 the Japanese economy has fallen into its deepest postwar recession. Because fiscal policy and monetary policy are at their limits, foreign exchange policy has gained wide attention to combat recession and deflation.

For instance, McCallum (2000) proposes to stimulate Japanese output through sterilized foreign exchange intervention. Meltzer (1999) states that yen devaluation by unsterilized foreign currency purchases would restore Japan's competitive position in the world economy and thus support a sustained recovery. Svensson (2001) presumes to have found a "*foolproof way of escaping from the liquidity trap*" by combining an inflation target with a real yen depreciation. The IMF (2001: 33-34) has urged the Bank of Japan "*to use all instruments at its disposal to combat deflation*", i.e., to further expand money supply and to depreciate the yen.

However, Okina (1999: 179) from the Bank of Japan has rejected the demands for a weaker yen. Large scale purchases of foreign currency by the Japanese authorities with the aim of depreciating the yen could provoke opposition from its major trading partners and be criticized as a beggar-thy-neighbor policy. Similarly, Japan's small East Asian neighbor countries oppose strongly a weaker yen (The Economist 2002).

The proponents of a yen depreciation have rejected the concerns that a significant yen depreciation could hurt Japan's smaller neighboring economies. Bernanke (2000: 161) argues that the beggar-thy-neighbour argument has its origins in the Great Depression, but does not apply to contemporary Japan and East Asia. According to Meltzer (1999: 189-190) a yen devaluation has no strong negative impacts on Japan's trading partners, particularly if the positive impact of a Japanese recovery is counted: "*In my view - and supported by the experience of the past decade - devaluation would be a cheaper, and I believe, faster way to restore prosperity to Japan and its neighbours*."

Svensson (2001) and the IMF (2000: 28-30, 2001: 28-29) assume that the negative effect which a yen depreciation might cause in East Asia's smaller countries would be more than offset by more Japanese imports from the region. In an IMF working paper Callen and McKibbin (2001) apply a macroeconomic G-cubed Asia-Pacific model with international trade and capital flows to explore the impact of a yen depreciation on the small East Asian economies. They find that monetary expansion and depreciation in Japan have "*minimal*" effects (p. 35) on the rest of Asia.

Building on the work of C.H. Kwan (2001) we show that the opposite is true. The negative effects of a yen depreciation on output in the smaller East Asian economies is stronger than the positive impact of more Japanese imports from the region. We show that, since the early 1980s, the smaller East Asian economies have experienced a synchronized business cycle that can be closely linked to the fluctuations in the yen/dollar exchange rate.

2. Growing Economic Integration and Synchronized Business Cycles in East Asia

Since the early 1980s, East Asian countries outside Japan chose a development strategy based on international trade and sound macroeconomic policies. Their subsequent rapid export-led economic growth with fiscal balance and relative price-level stability led to what the World Bank (1993) called the "The East Asian Miracle".

Less well known is that these high-growth economies have experienced a synchronized business cycle. Figure 1 shows that, since 1980, the real GDPs of the smaller East Asian economies have fluctuated in parallel. In particular, growth rates of Hong Kong, Indonesia, Korea, Malaysia, Taiwan, and Thailand have been highly correlated. These countries are the core of the East Asian business cycle, to which the Philippines and Singapore are more loosely attached.

For ease of notation, let us denote the bloc of the eight smaller East Asian countries—Hong Kong, Korea, Singapore, Taiwan, Indonesia, Malaysia, the Philippines, and Thailand—by EA_1. Then EA_2 is EA_1 plus China; and EA_3 is EA_2 plus Japan.

Output synchronization in the EA_1 countries springs from several related factors. First, their regional proximity and growing direct trade linkages have strengthened economic interdependence. More indirectly, they have been export competitors in third markets such as the United States and Japan. Second, they followed similar exchange rate, monetary, and fiscal policies. Third, the EA_1 countries were and are similarly affected by exogenous fluctuations in the yen/dollar exchange rate, our primary focus in this paper.

International trade has been the driving force behind the "miracle" growth with rapid industrialization. Initially, the East Asian economies relied heavily on exports to, and imports from, the United States, Japan, and other industrial countries. In the last two decades, however, intra East Asian trade became relatively more important (Urata 2001). From 1980 to 2000, Table 1 shows that exports to other EA_1 countries rose from 18.9% to 27.4% of overall EA_1 exports. The share of imports from other EA_1 countries increased from 15.3% to 26.7%. If China is included, the share of intraregional trade increases further: EA_2 exports to other EA_2 countries increased from 21.7% in 1980 to 37.3% in 2000.

In contrast, East Asian trade with industrial countries other than the United States has declined comparatively. Table 2 shows that EA_1 exports to Japan fell from 19.2% in 1980 to 10.8% in 2000—although imports from Japan fell somewhat less. The relative shift away from trade with Rest of World (ROW) is even more striking.[1] The share of exports to ROW as a percentage of overall exports declined from 37.3% in 1980 to 28.5% in 2000. Including China, Table 2 also shows that the relative decline in EA_2 trade with ROW is just as pronounced.

[1] ROW trade is dominated by the European countries.

Instead of relying on the industrial countries as the sole driving force of their catch-up process, the smaller East Asian countries have developed their own economic dynamics. While there is no doubt that the intensification of intra-Asian trade and the synchronization of the business cycles are closely intertwined, the causality is unclear. Do closer trade linkages contribute to a common business cycle or are there common external shocks, or both?

Theoretically, rising trade between two countries can result in greater or weaker synchronization of aggregate demand fluctuations (Frankel and Rose 1998). If two countries engage in Heckscher-Ohlin or Ricardian type trade, they become more specialized in certain economic sectors or industries. Thus their business cycles tend to be more idiosyncratic. As trade in dissimilar products between two countries increases, with one country specializing in the production of, say, cars and the other specializing in the production of palm oil, both countries will react differently to exogenous shocks. Business cycles will differ.

Suppose, however, intra industry trade predominates as in electrical equipment and semiconductors. Because one country both imports from, and exports this equipment to the other, exogenous shocks will affect both in the same way. Business cycles will be synchronous. A sudden decline in the demand for computers would slow economic growth in both countries.

Because both types of trade patterns can be observed, the impact of strengthened trade linkages on the common business cycle is ambiguous. First, the “newly” industrialized club of Hong Kong, Korea, Singapore, and Taiwan—of which China is an increasingly important member—have rather highly developed and capital-intensive industries where intra-industry trade could be important. Second, the ASEAN core countries of Indonesia, Malaysia, Philippines, and Thailand focus more on agricultural products, raw materials, and labor-intensive products, where intra-industry trade is less important. Between the two groups, however, inter-industry trade would seem to predominate.

The upshot is that industry-specific random shocks are unlikely to generate the highly synchronized business cycles shown in Figure 1. Instead we must look for macroeconomic shocks that affect aggregate demand and broad industrial competitiveness across the board in East Asia outside of Japan, hence our focus on fluctuations in the yen/dollar exchange rate.

3. Fluctuations in the Yen/Dollar Exchange Rate: The Loose Cannon

We base our argument on the fact that East Asian countries except Japan tend to stabilize their exchange rate against the US dollar—what McKinnon (2000, 2001) called “The East Asian Dollar Standard”. During the 1980s up to the Asian crisis of 1997-98, all smaller East Asian countries pegged to the US currency—more on a high frequency week-to-week basis, but with some drift at lower frequencies of observation. In 2002, there is strong evidence that the East Asian countries other than Japan are returning to their pre-crisis practices of pegging to the dollar (McKinnon and Schnabl 2002). Indeed, now China, Hong Kong, and Malaysia appear to be firmly pegged to the dollar at all frequencies of observation. Because the dollar is the dominant currency for invoicing intra regional trade and denominating international capital flows, the smaller East Asian economies peg to the dollar to reduce payments risk and to anchor their domestic price levels. But this leaves them vulnerable to changes in the yen/dollar exchange rate.

Due to their export orientation and their relatively small size, the EA_1 economies are already very open. In 2000, trade (exports + imports) as a percentage of GDP ranged from 71% in Indonesia to 196% in Singapore. Although international trade has been—and will be—a critical factor in their economic success, it also increases their collective vulnerability to foreign "shocks". And fluctuations in the yen/dollar exchange rate have been most important of these shocks.

Alone among East Asian countries, Japan has chosen, or been forced to accept (McKinnon and Ohno 1997), a situation where its currency varies widely against the dollar (Figure 2). Since early 1971, Figure 2 shows the yen appreciating from its Bretton Woods Parity of 360 yen per dollar to around 120 yen per dollar today. Although the trend of continual yen appreciation seemingly (temporarily?) ended in 1995, fluctuations in the yen/dollar exchange rate have not abated in the last decade. Figure 2 also shows the large variations in the yen/dollar exchange rate since 1990.

By keeping their exchange rates stable against the dollar, the smaller East Asian economies must cope with extraneous fluctuations of the dollar against the yen. To illustrate the magnitude of this problem over the past decade, Figure 3 shows large fluctuations of the yen against the Hong Kong dollar—which remained firmly pegged to the US dollar since the early 1980s. Clearly, the yen/dollar exchange rate is a volatile outlier in the East Asian exchange rate system. This imbalance has important consequences.

The yen/dollar exchange rate affects collective EA_1 output in two ways: trade and foreign direct investment (Kwan 2001). The first is a real exchange rate or international competitiveness effect. Yen/dollar fluctuations impact Japan's international competitiveness both against the United States and against all the other East Asian countries—which are pegged to the dollar. While yen appreciation stimulates EA_1 exports, yen depreciation is a dangerous threat because it impairs the international competitiveness of the EA_1 economies. When the yen depreciates, EA_1 imports and competition from Japanese goods increase while their exports to Japan as well as to third markets decline.

Figure 4 shows that the exports of the smaller East Asian countries have fluctuated with the yen/dollar exchange rate. When the yen appreciated, such as following the Plaza Agreement (September 1985), EA_1 exports strongly expanded. In contrast, yen depreciation after 1995 slowed East Asian export expansion significantly. The change in overall EA_1 exports can be subdivided into a Japan, an intra-Asian, and a third market effect. Although not plotted here, all the three effects move in parallel with respect to changes in the yen/dollar exchange rate.

The second transmission channel is Japanese foreign direct investment (FDI) into the rest of East Asia. FDI is highly correlated with the yen/dollar exchange rate. FDI accelerates when the yen appreciates (Figure 5) because production and investment in Japan itself becomes relatively more expensive. When the yen is high and appreciating, the influx of Japanese long-term capital and know-how boosts domestic gross fixed investment in EA_1 and stimulates output—and vice versa when the yen is low.

The exchange-driven nature of Japanese FDI was particularly pronounced in the early 1990s. When the yen rose from 145 per dollar in 1990 to less than 80 per dollar in 1995, Japanese FDI to EA_1 increased fast (Figure 5). Japanese multinationals and even small and medium enterprises shifted unprofitable (parts of) the production process to the low-wage and generally lower-cost East Asian countries. In

Japan, this rationalization process was perceived as hollowing out (*kûdôka*) of the Japanese economy, while it provided an additional growth stimulus to its small neighbors.

Froot and Stein (1991) give another explanation for the dependence of FDI on exchange rates. The exchange rate affects foreign direct investment (and thus domestic investment) more when firms are capital constrained. The profits of an FDI acquisition of real estate or production facilities are much more difficult to know for outsiders than is the case for portfolio investment because of asymmetric information.[2] Thus, the more internal financing (wealth) a firm can bring into an FDI project, the lower will be the total costs. An appreciation of the domestic currency increases the relative net worth of the domestic enterprise for investing abroad, and the domestic investor can bid more aggressively for foreign assets. The FDI out of the home country increases.

Figure 6 shows that the EA_1 countries[3] tend to grow faster when the yen is appreciating—and vice versa. But lags are involved so that a more formal regression analysis is necessary to show the full impact, both collectively and individually, on income growth in the other East Asian countries.

4. The Impact of Yen/Dollar Fluctuations on Regional Output

Fluctuations in the yen/dollar exchange rate have a pervasive effect on Japan's East Asian neighbors. We estimate the impact of yen/dollar exchange fluctuations on regional output econometrically. Our focus is on the yen/dollar exchange rate as well as on the output in the smaller East Asian countries, China, Japan, and the US.

Consider first the econometric model of Kwan (2001: 38-41). For the period 1982-97, Kwan regressed the real growth rate of EA_2 (EA_1 plus China) on yearly changes in the yen/dollar exchange rate ($e_{YenDollar}$) and on real growth in the US (y_{US}). Kwan's multivariate distributed lag model of economic interdependency in East Asia is described by equation 1.

$$y_{EA_2\,t} = \beta_1 + \beta_2 y_{US_t} + \beta_3 e_{YenDollar_t} + \beta_4 e_{YenDollar_{t-1}} + u_t \qquad (1)$$

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2 External financing is assumed to be more expensive than internal financing because external creditors face higher costs to observe profits. While the domestic enterprise knows the profit of an FDI project, the outside creditor faces higher costs to acquire the information about the "true" return.

3 The EA_1 real growth rate (y_{EA_1}) is calculated as weighted average of the real growth rates of eight (k = 8) small East Asian countries by the formula:

$$y_{EA_1\,t} = \sum_{i=1}^{8} y_{i\,t} \frac{Y_{i\,t}}{\sum_{i=1}^{8} Y_{i\,t}}$$

Y_i is the nominal GDP of country i in terms of dollar and y_i is the real GDP growth rate of country i.

Table 3 reports our re-estimated coefficients of Kwan's model. As Kwan did, we used yearly data because quarterly data on real GDP are not available for most East Asian countries for the whole observation period. All regressions are run with yearly rates of change (first differences) to avoid problems caused by nonstationarity.[4] As Kwan found, Table 3 shows a strong inverse correlation between the yen/dollar exchange rate and growth in EA_2. For every one percent increase in the yen/dollar rate both current and lagged one year, Table 3 shows that real growth in EA_2 falls about 0.15%.[5]

To further investigate the transmission of business cycles in East Asia, we modified Kwan's model in four respects. First, we introduced the impact of Japanese output fluctuations on the other East Asian countries as an additional exogenous variable.[6] Second, we disaggregated Kwan's model down to the individual country level to test whether fluctuations in the yen/dollar exchange rate have a different impact on output across Asian countries. Third, we isolated the important role of China within the East Asian macro system. Fourth, we identified the cyclic spillover effects from the EA_1 countries as a whole to individual members.

The estimations are performed in three steps. In step one, we estimate only the interactive output effects in East Asia from which exchange rate effects are excluded. The impact of changes in output in the US, China, Japan and $REA1_j$ (the EA_1 countries other than the j^{th} one being considered) on output of the single East Asian country *j* is estimated. In step two, the impact of the yen/dollar exchange rate on output in the East Asia countries collectively and individually is estimated. Step three combines step one and two.

4.1 Measuring Output Fluctuations

In step 1, we show how output fluctuations in the large countries—Japan, China, and the United States—influence output in the smaller East Asian economies. Let y_{Japan}, y_{China}, y_{US} and y_{REA1j} be annual growth in real output in Japan, China, the United States, and the rest of EA_1 (EA_1 except country *j*) respectively. We then regress the economic growth of country *j* on these variables.

But economic growth in Japan and $REA1_j$ are interdependent. Thus the assumption of independence between the exogenous variables is violated. To cope with this problem, we run a simple univariate regression of y_{REA1j} on y_{Japan} as the exogenous variable.[7] The resulting residuals were then used in

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4 For most countries the Augmented Dickey-Fuller test does not reject the null hypothesis of a unit root. Yet we view this acceptance as due to the low power of the test for our very short sample period.

5 The coefficients of the current and previous periods are added to a long-run exchange rate multiplier. The long-run exchange rate multiplier is more accurately explained below.

6 In reality Japanese growth is not exogenous, but strongly dependent on EA_1 growth. Nevertheless, since it is the main goal of this paper to describe the EA_1 business cycle, we treat Japanese growth as exogenous.

7 $y_{REA1_{j_t}} = \beta_1 + \beta_2 y_{Japan_t} + u_t$ with $u_t = y_{REA1_j - JAP_t}$. As will be proved below, the cyclical interdependence between EA_1 and China and the US is comparatively weak. Therefore, we don't control EA_1 growth for the impact of growth in China or the US.

equation 2 as a right hand side variable $y_{REA1j\text{-}Jap}$ to represent East Asian growth filtered by the impact of Japanese growth. More generally, we then estimate real growth in the individual EA_1 countries and in EA_1 as a whole:

$$y_{j_t} = \beta_1 + \beta_2 y_{\mathrm{US}_t} + \beta_3 y_{\mathrm{Japan}_t} + \beta_4 y_{\mathrm{China}_t} + \beta_5 y_{\mathrm{REA1}_j-\mathrm{Jap}_t} + u_t \qquad (2)$$

The regression results are reported in Table 4, where the effect of fluctuations in each of these larger countries on the individual smaller ones is shown. There are four main findings. First, the business cycles in China and the US have no measurable impact on the output fluctuations of the East Asian countries.[8] All coefficients for the US (β_2) and China (β_4) in equation 2 are insignificant. Only Taiwan's output fluctuations somewhat depend on those in the United States.

Secondly, as depicted in Figure 1, the evidence for a common business cycle in the small East Asian economies is strong—as reflected by the β_5 coefficients for $REA1_j$ in equation 2. For all the EA_1 countries except Singapore and Taiwan shown in Table 4, the β_5 coefficients are significant. This coefficient is significant at the 1% level for five countries (Hong Kong, Indonesia, Korea, Malaysia, Thailand) and at the 5% level for the Philippines. Taiwan's coefficient is close to the 10% level of significance. The interactive output effects among the smaller Asian economies are particularly pronounced in Hong Kong, Indonesia, Korea, Malaysia and Thailand. And, not coincidentally, these countries were the hardest hit during the Asian crisis by the general contagion.

Third, Japan has a pivotal role for the business cycle of EA_1. Japanese output changes have a significant impact on six out of eight East Asian countries—Hong Kong, Indonesia, Korea, Malaysia, Taiwan and Thailand. The coefficients for two countries (Indonesia and Thailand) are significant at the 1% level. Only the business cycles of the Philippines and Singapore seem not to be linked to Japan's. For EA_1 as a whole, the impact of Japan's business cycle is significant at the 5% level.

Fourth, our estimates show that neither the US, nor Japan, nor the EA_1 countries collectively, significantly influence fluctuations in China's output—whose business cycle seems to be relatively uncorrelated with those in other Asian countries. China's economic development mainly relies on domestic growth, and is comparatively immune to exogenous shocks from abroad.

4.2 Measuring Exchange Rate Effects

Despite the positive correlation of East Asian and Japanese output, their business cycles are far from being totally synchronized. Because of the asymmetric impact of changes in the yen/dollar exchange rate, Japanese and East Asian business cycles could diverge. The impact of a higher yen is to depress growth in Japan while stimulating it in the rest of East Asia.

[8] However, although not measured in our sample, the downturn in U.S. high tech industries in 2001 did significantly affect the smaller East Asian economies, particularly Korea, Taiwan, and Singapore.

In step 1, we measured interactive output effects while ignoring the exchange rate. Now, in step 2, we measure *just* the concurrent and lagged effect of the exchange rate on output in *each* of the East Asian countries. Concurrently, i.e., within the year corresponding to our annual observations, changes in the yen/dollar affect the competitiveness of exports (Figure 13). But also with a lag of one or two years, the further influence of foreign direct investment on output seems evident.

After regressing different lag lengths of the yen/dollar exchange rate on annual output changes for every East Asian country, lags of three periods or longer become insignificant. Therefore we report on regressions with a maximum lag of two years—as summarized in equation 3:

$$y_{j_t} = \gamma + \sum_{i=0}^{2} \beta_i e_{\text{Yendollar}_{t-i}} + u_t \qquad (3)$$

In equation 3, again there is the problem of multicollinearity where successive time series data on the yen/dollar exchange rate tend to be correlated. For any one estimated coefficient, its standard error is "too" large leading to an underestimation of its true t-value. However, the coefficients associated with each lag are still unbiased and efficient, and the overall fit of the model is adequately reflected in the R^2 and F-statistics. To measure the cumulative or long-run effect of a change in the yen/dollar rate, we can simply sum the three coefficients for the zero, one, and two-year lags.

The results of so estimating equation 3 are reported in Table 5. The negative impact of the yen/dollar exchange rate on the outputs of the individual East Asian countries is strong. The coefficients for all countries including China are negative, or close to zero if positive. Six out of eight countries—Hong Kong, Indonesia, Korea, Philippines, Taiwan, and Thailand—show significant coefficients for the current or for the lagged exchange rate. For Malaysia, the t-value for β_2 is close to being significant at the 10% level.

More important are the long-run "multipliers" capturing the cumulative effect of exchange rate changes for all three periods—as shown in the right hand column of Table 5.[9] These are negative for all countries and range from -0.51 for Thailand to -0.07 for China. All t-values of the long-run multipliers (except for China and Singapore) are significant—and are particularly high for Thailand, Hong Kong, Indonesia, and Korea. The country with the highest value, i.e., that showing the greatest sensitivity to the yen/dollar, is Thailand—which of course is where the Asian crisis was triggered.

Although most EA_1 countries are affected significantly by changes in the yen/dollar exchange rate, the adjustment patterns are heterogeneous. For Hong Kong, Korea, and Taiwan—sometimes called Newly Industrialized Economies (NIEs)—the short-run multipliers are high and significant, while the intermediate multipliers fade out. The former could reflect the more immediate loss in competitiveness of the NIEs' exports from a yen depreciation.

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9 The long-run multiplier β^* is calculated as total sum of all short-run elasticities by the formula: $\beta^* = \sum_{i=0}^{2} \beta_i$

In contrast, the exchange rate effects on the ASEAN 4 countries—Indonesia, Malaysia, Philippines and Thailand—in the short term are low, but the lagged effects are stronger. The slow adjustment in these countries, whose exports don't compete directly with Japan, might reflect the lagged effect on FDI from exchange rate changes. When the yen depreciates Japanese (foreign direct) investment in the ASEAN 4 countries decreases, and their growth eventually declines. Because the planning horizon for FDI is longer, the adjustment process is slower.

Finally, we see that China alone—along with Singapore—has not been significantly affected by fluctuations in the yen/dollar exchange rate.

Although somewhat different, the responses of the individual NIEs and the ASEAN 4 to yen/dollar fluctuations rate cumulate to a common reaction pattern for the EA_1 as a whole. Overall, Table 5 strongly supports our view that the common EA_1 business cycle is generated largely by fluctuations in the yen/dollar exchange rate.

4.3 Measuring Output Fluctuations and Exchange Rate Effects Simultaneously

In steps 1 and 2, interactive output effects (Table 4) and exchange rate effects (Table 5) were estimated separately from of equations 2 and 3 respectively. Now, to avoid specification bias, interactive output effects and exchange rate effects in East Asia are estimated jointly.

Including insignificant variables, such as output growth in China and the US, in equation 2 is of minor concern. The estimators are still unbiased, and the t-statistics remain valid—although their standard errors might have increased compared to a completely specified model. But, by dropping China and the US as explanatory variables, we gain degrees of freedom without losing accuracy.

Omitting a significant explanatory variable and thus under fitting the model could introduce more serious specification bias. We omitted the exchange rate from equation 2, and omitted Japanese and REA1j output from equation 3. If the yen/dollar exchange rate is correlated with Japanese or REA1*j* output growth,[10] the estimated coefficients and variances in each equation can be biased. The included variable may measure not only its own direct influence, but also capture the indirect impact of what is omitted. Thus, to reduce this specification bias, equations 2 and 3 are combined to get:

$$y_{j_t} = \beta_1 + \beta_2 y_{\text{Japan -YenDollar}_t} + \beta_3 y_{\text{REA1}_j\text{-Jap-YenDollar}_t} + \beta_4 e_{\text{YenDollar}_t} + \beta_5 e_{\text{YenDollar}_{t-1}} + \beta_4 e_{\text{YenDollar}_{t-2}} + u_t \qquad (4)$$

In estimating equation 4, how do we adjust for multicollinearity? Japanese output growth is influenced by the yen/dollar exchange rate. $REA1_j$ output is strongly influenced by Japanese output and the yen/dollar exchange rate (up to two lags). Thus, we again regressed Japanese output on the yen/dollar exchange rate and used the resulting residuals as the exogenous variable $y_{\text{Japan-YenDollar}}$ in equation 4. But now we regress $REA1_j$ output on Japanese output and on the yen/dollar exchange rate (two lags). The resulting residuals, $y_{\text{REA1}_j\text{-Jap-YenDollar}}$, is also an explanatory variable in equation 4.

[10] The partial correlation coefficient is larger than zero-as shown in Table 5.

The main determinants of the EA_1 business cycle, the regression coefficients from estimating equation 4, are reported in Table 6. Compared to equations 2 and 3, the goodness of fit increases for all countries despite the fewer degrees of freedom. The long-run multiplier, i.e., the cumulative effects, of exchange rate changes on output in EA_1 remains stable—while t-values increase further. Clearly, the yen/dollar rate is a pivotal determinant of the business cycle of all EA_1 countries individually (except Singapore) and of EA_1 as a whole.

Differences exist between the more general model of equation 4 and the less inclusive models of equations 2 and 3. By adding the exchange rate as an exogenous variable, some effects change substantially. For instance, Japanese output no longer has any effect on Malaysian output. All in all, however, Table 6 supports our hypothesis of the strong impact on the smaller East Asian economies of changes in Japanese output and the yen/dollar rate as well as the interactive output effects among themselves.

But Table 6 also shows that China's economic growth remains comparatively immune to fluctuations in the yen/dollar rate and to business cycle fluctuations in other East Asian economies. When regressing China's output growth on output growth in EA_1 and on the yen/dollar exchange rate, the regression coefficients are insignificant. Clearly, because of its large and growing size, China is an important stabilizing force in dampening the magnitude of cyclical fluctuations in its smaller East Asian neighbors.

4.4 Japan's Interaction with the Smaller East Asian Economies: A Summary

To summarize the main sources of instability in the East Asian economy, Table 7 is a taxonomy of the macroeconomic impact of events in the Japanese economy—changes in the yen/dollar rate and Japan's business cycle—on the income of EA_1. There are four possible combinations of changes in the yen/dollar rate and upswings or downswings in Japanese income. The plus signs in the body of the table indicate an expansionary effect on EA_1—with minus signs indicating contraction.

Case 1 is the best outcome for EA_1 countries. The yen appreciates against the dollar while the Japanese economy is expanding. The positive income effect and exchange rate effect reinforce each other to stimulate aggregate output. But discrete episodes are difficult to identify in the data.

Case 4 is the worst outcome for the EA_1 countries. Yen depreciation is aggravated by an economic downswing in Japan. This case was observed during the Asian crisis of 1997-98 when Japanese income turned down as the yen fell.

Case 2 applied in 1986-87 and again in the early 1990s up to 1995. In each episode, the strong yen was accompanied by a recession in Japan, what was widely characterized as "*high-yen induced recession*" (*endaka fukyô*). While the recessions had a negative effect on the EA_1 economies, the yen appreciations boosted growth—with this exchange rate effect predominating. The EA_1 economies experienced high growth in both cases.

Case 3 seems to apply from mid 1995 through 1996. Japan's output increased as the yen declined. The initial net effect on EA_1 was positive. But eventually the falling yen—which bottomed out at 147 to the dollar in June 1998—helped provoke the great Asian crisis, putting us back into Case 4.

Again we learn that the exchange rate effect usually dominates the income effect—an important empirical regularity to keep in mind when we discuss whether a deep devaluation of the yen would permit Japan to export its way out of its current slump.

5. Conclusion

Our message is clear: the yen should not be depreciated below some rough measure of purchasing power parity (PPP)—as per the current rate of 120 to 130 yen per dollar—to "boost" the Japanese economy. More generally, ongoing fluctuations in the yen/dollar rate around PPP increase the volatility of the business cycle in the smaller East Asian economies. They would be much better off if the yen was permanently tethered.

Other economists have recognized how fluctuations in the yen/dollar rate destabilize economies in the ever-more-integrated East Asia region. But their common policy "solution" is to give the yen more weight in the exchange rate baskets of the nine countries (Williamson 2000, Kwan 2001). However, this proposed solution is misplaced. Why change the monetary and exchange rate policies of nine East Asian countries—including big ones like China and Korea—whose revealed preferences are to peg to the dollar (McKinnon and Schnabl 2002), when changing just Japan's would be sufficient?

Putting the matter more positively for Japan itself, Goyal and McKinnon (forthcoming) show that the fluctuating yen has been a prime cause of Japan's low interest rate liquidity trap and its failure to escape from the ongoing slump. Thus, stabilizing the yen/dollar rate in nominal terms indefinitely would benefit Japan on the one hand and its East Asian neighbors on the other. But for any such exchange rate agreement to be credible would require the cooperation of the United States—specifically through joint action by the US Federal Reserve Bank and the Bank of Japan (McKinnon and Ohno, 1997, 2001). But that is a story for another time.

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Table 1. Intra-Asian Trade, 1980-2000

	Exports			Imports		
	EA_3	EA_2	EA_1	EA_3	EA_2	EA_1
EA_1						
1980			18.9			15.3
1990			22.2			19.6
2000			27.4			26.7
EA_2						
1980		21.7			18.2	
1990		32.0			30.1	
2000		37.3			41.0	
EA_3						
1980	32.0			31.8		
1990	39.6			42.9		
2000	46.5			54.9		

Source: IMF: Direction of Trade Statistics. EA_1 = Hong Kong, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan, Thailand, $EA_2 = EA_1$ + China, $EA_3 = EA_2$ + Japan

Table 2. East Asian Trade with China, Japan, US, and ROW, 1980-2000

	Exports				Imports			
	China	Japan	US	ROW	China	Japan	US	ROW
EA_1								
1980	1.5	19.2	23.1	37.3	4.7	23.8	17.1	39.1
1990	6.4	14.4	24.9	32.0	9.4	23.0	16.1	31.9
2000	11.9	10.8	21.4	28.5	14.7	19.6	14.3	24.8
EA_2								
1980		19.6	20.9	37.6		24.2	17.4	40.2
1990		14.4	22.5	31.1		21.9	15.6	32.4
2000		12.0	21.9	28.9		19.2	13.3	26.6
EA_3								
1980			22.6	45.4			17.4	50.8
1990			26.2	34.2			18.1	39.0
2000			24.2	29.2			14.8	30.3

Source: IMF: Direction of Trade Statistics. EA_1 = Hong Kong, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan, Thailand, $EA_2 = EA_1$ + China, $EA_3 = EA_2$ + Japan, ROW = Rest of the World.

Table 3. The Kwan-Model of Fluctuations in East Asian Output (EA_2), 1982 - 2000

US GDP Growth	Yen/Dollar Exchange Rate		Adj. R^2	Durbin-Watson
	Current	One year lag		
0.18			-0.02	1.09
(0.71)				
	-0.09**		0.22	1.42
	(-2.45)			
	-0.07*	-0.08**	0.40	1.51
	(-2.08)	(-2.49)		
0.12	-0.08**		0.19	1.44
(0.52)	(-2.32)			
0.10	-0.06*	-0.08***	0.37	1.47
(0.53)	(-1.97)	(-2.42)		

Note: The dependent variable is annual output growth in EA_2. Data source: IMF: IFS, Central Bank of China. All estimations in terms of change rates (coefficients correspond to elasticities). Figures in parentheses denote t-values. * significant at the 10% level. ** significant at the 5% level. *** significant at the 1% level.

Table 4. Mutual Determinants of East Asian Output, 1982 - 2000

j	US	Japan	China	$REA1_j$	R^2 adj. (R^2)
Hong Kong	0.40	0.57*	0.24	1.20***	0.54
	(1.10)	(2.02)	(1.14)	(4.31)	(0.65)
Indonesia	-0.16	1.09***	0.21	1.22***	0.64
	(-0.43)	(3.68)	(0.96)	(4.39)	(0.72)
Korea	-0.13	0.86**	0.04	0.92***	0.43
	(-0.34)	(2.86)	(0.19)	(3.05)	(0.56)
Malaysia	-0.33	0.60*	-0.01	1.27***	0.46
	(-0.78)	(1.80)	(0.03)	(3.89)	(0.58)
Philippines	-0.22	-0.05	-0.65**	0.70**	0.36
	(-0.54)	(-0.17)	(-2.74)	(2.28)	(0.50)
Singapore	0.06	-0.10	-0.16	0.39	-0.16
	(0.11)	(-0.25)	(-0.54)	(1.07)	(0.10)
Taiwan	0.49*	0.36*	0.07	0.40	0.23
	(1.84)	(1.74)	(0.45)	(1.69)	(0.40)
Thailand	-0.49	1.42***	0.12	1.22***	0.75
	(-1.47)	(5.51)	(0.60)	(4.82)	(0.81)
China	0.58	0.10		-0.02	-0.04
	(1.48)	(0.30)		(-0.06)	(0.11)
EA_1	0.02	0.61**	-0.01		0.11
	(0.06)	(2.26)	(-0.08)		(0.26)

Note: The dependent variable is annual output growth of the respective EA_2 countries. Data source: IMF: IFS, Central Bank of China. $REA1_j$ = EA_1 excluding country *j*. T-Statistics in parentheses. * significant at the 10% level. ** significant at the 5% level. *** significant at the 1% level.

Table 5. Exchange Rate Determinants of East Asian Output, 1982 - 2000

	Yen/dollar$_t$	Yen/dollar$_{t-1}$	Yen/dollar$_{t-2}$	R^2 adj. (R^2)	LRM
Hong Kong	-0.17**	-0.15*	0.01	0.37	-0.31***
	(-2.39)	(-2.06)	(0.08)	(0.48)	(-3.04)
Indonesia	-0.06	-0.10	-0.19*	0.20	-0.35**
	(-0.67)	(-1.09)	(-1.96)	(0.33)	(-2.54)
Korea	-0.17**	-0.04	-0.10	0.12	-0.31**
	(-2.11)	(-0.48)	(-1.29)	(0.35)	(-2.73)
Malaysia	0.02	-0.11	-0.15	0.11	-0.24*
	(0.20)	(-1.08)	(-1.62)	(0.25)	(1.76)
Philippines	-0.00	-0.04	-0.18**	0.14	-0.22*
	(-0.03)	(-0.51)	(-2.15)	(0.28)	(1.88)
Singapore	0.01	-0.13	-0.01	-0.01	-0.13
	(0.16)	(-1.55)	(-0.10)	(0.16)	(-1.11)
Taiwan	-0.11**	-0.06	0.00	0.30	-0.17**
	(-2.43)	(-1.39)	(0.19)	(0.41)	(-2.51)
Thailand	-0.10	-0.17*	-0.24***	0.50	-0.51***
	(-1.23)	(-2.03)	(-2.30)	(0.59)	(-4.39)
China	-0.06	-0.07	0.04	-0.05	-0.07
	(-0.78)	(-0.97)	(0.48)	(0.13)	(-0.88)
Japan	0.03	-0.05	-0.10**	0.22	-0.12*
	(0.58)	(-1.09)	(-2.19)	(0.34)	(-1.91)
EA_1	-0.10*	-0.09*	-0.09*	0.43	-0.28***
	(-2.13)	(-1.79)	(-1.90)	(0.53)	(-4.05)
EA_2	-0.07**	-0.08**	-0.03	0.42	-0.18***
	(-2.30)	(-2.17)	(-1.02)	(0.52)	(-3.98)

Note: The dependent variable is annual output growth. Data source: IMF: IFS, Central Bank of China. LRM = long-run exchange rate multiplier. T-Statistics in parentheses. * Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level.

Table 6. Output and Exchange Rate Effects in East Asia, 1982 - 2000

	Japan	$REA1_j$	Yen/dollar	Yen/dollar$_{t-1}$	Yen/dollar$_{t-2}$	LRM	R^2 adj. (R^2)
Hong Kong	0.65*	0.92**	-0.17***	-0.16**	-0.02	-0.35***	0.61
	(2.02)	(2.65)	(-3.06)	(-2.66)	(-0.41)	(-3.68)	(0.71)
Indonesia	0.84**	1.56***	-0.07	-0.12*	-0.15**	-0.34***	0.66
	(2.45)	(4.00)	(-1.09)	(-1.81)	(-2.44)	(-3.74)	(0.75)
Korea	0.97***	0.91**	-0.17***	-0.03	-0.10*	-0.30***	0.60
	(3.12)	(2.57)	(-3.09)	(-0.47)	(-1.72)	(-3.64)	(0.75)
Malaysia	0.19	2.10***	0.02	-0.11**	-0.14**	-0.23***	0.79
	(0.75)	(7.02)	(0.37)	(2.26)	(-2.99)	(-3.43)	(0.84)
Philippines	-0.89**	0.73**	-0.00	-0.05	-0.18**	-0.23**	0.42
	(-2.40)	(1.82)	(-0.02)	(-0.66)	(-2.69)	(-2.35)	(0.58)
Singapore	-0.56	0.25	0.01	-0.13	-0.02	-0.14	-0.02
	(-1.19)	(0.53)	(0.17)	(-1.56)	(-0.21)	(-1.13)	(0.20)
Taiwan[11]	0.48**	0.08	-0.09**	-0.06	0.01	-0.14**	0.48
	(2.28)	(0.43)	(-2.58)	(-1.54)	(0.27)	(2.68)	(0.65)
Thailand	1.01***	0.95**	-0.10*	-0.16**	-0.23***	-0.49***	0.76
	(3.29)	(2.85)	(-1.81)	(-2.90)	(-4.13)	(6.16)	(0.83)
China	0.13	-0.53	-0.06	-0.07	0.03	-0.10	-0.08
	(0.29)	(-1.16)	(-0.76)	(-0.94)	(0.44)	(-0.88)	(0.21)
EA_1	0.44*		-0.10**	-0.08*	-0.08*	-0.26***	0.50
	(1.70)		(-2.35)	(-1.92)	(-1.95)	(-4.34)	(0.60)
EA_2	0.37**		-0.08**	-0.07**	-0.03	-0.18***	0.55
	(2.23)		(-2.60)	(-2.41)	(-1.02)	(-4.18)	(0.65)

Note: The dependent variable is annual output growth. Data source: IMF: IFS, Central Bank of China. $REA1_j$ = EA_1 excluding country j. LRM = long-run exchange rate multiplier. T-Statistics in parentheses. * Significant at the 10% percent level. ** Significant at the 5% level. *** Significant at the 1% level.

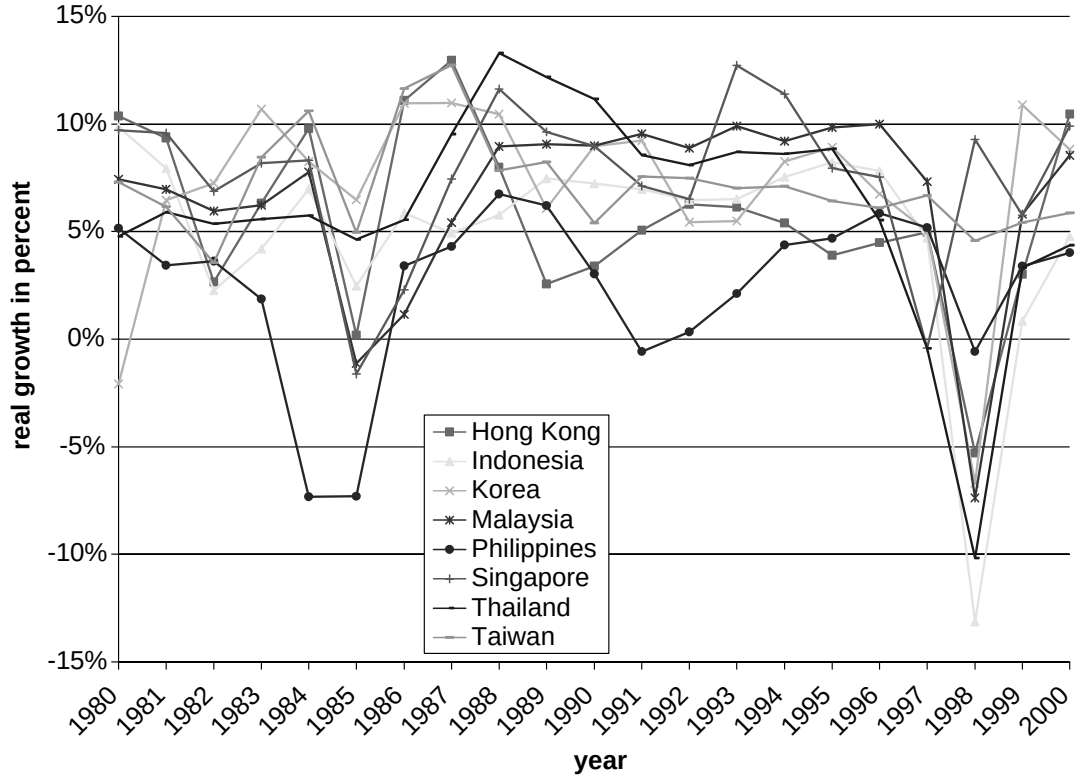
Table 7. Economic Interaction between Japan and the Smaller East Asian Economies

	Upswing in Japan	Downswing in Japan
Yen appreciation	(1) + / +	(2) – / +
Yen depreciation	(3) – / +	(4) – / –

Note: + indicates a positive impact on y_{EA_1}, and a — indicates a negative impact on y_{EA_1}.

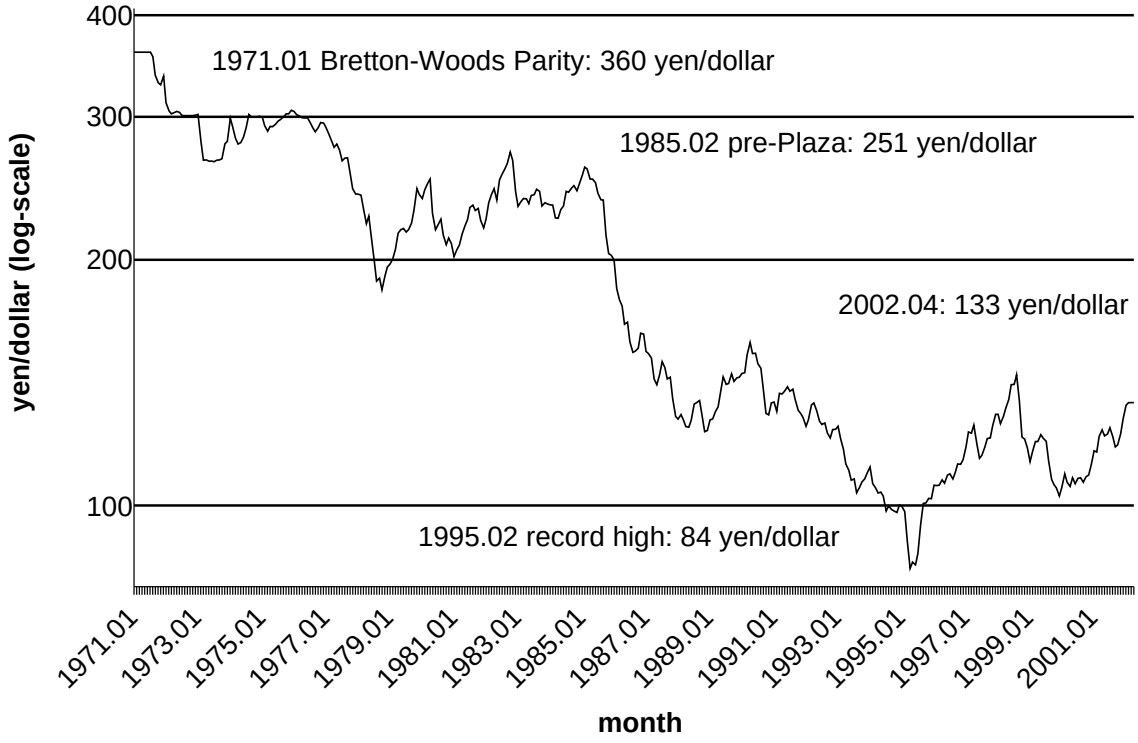
[11] The coefficient for US real growth is 0.44* (2.03).

Figure 1. Synchronized Business Cycles in East Asia (EA_1), 1980-2000 (Yearly)



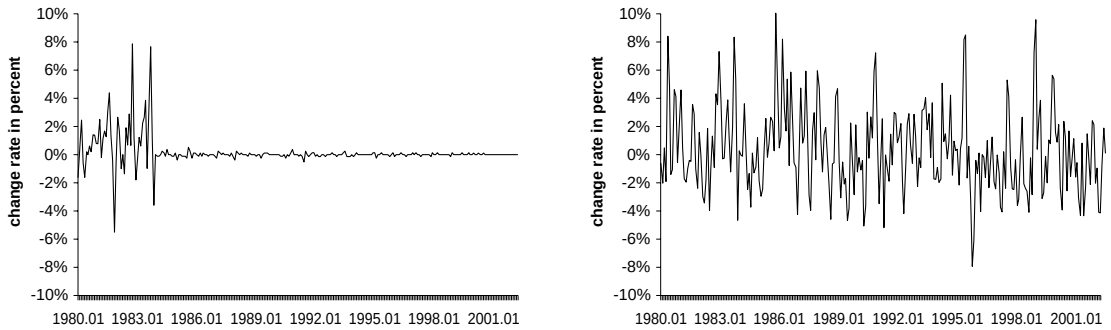
Source: IMF: IFS, Central Bank of China. EA_1 = Hong Kong, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan, Thailand.

Figure 2. Yen/Dollar Exchange Rate, 1971-2002 (Monthly)



Source: IMF: IFS.

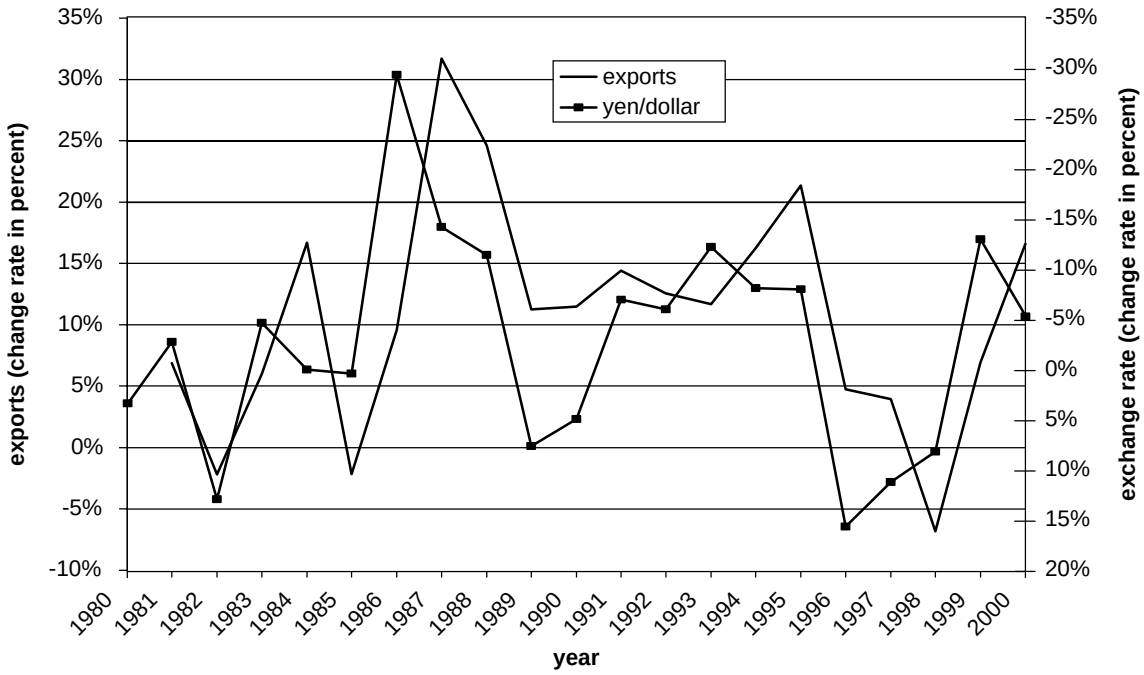
Figure 3. Volatility of the Exchange Rate of the Hong Kong Dollar, 1980-2002 (Monthly)



Against the US dollar | Against the Japanese yen

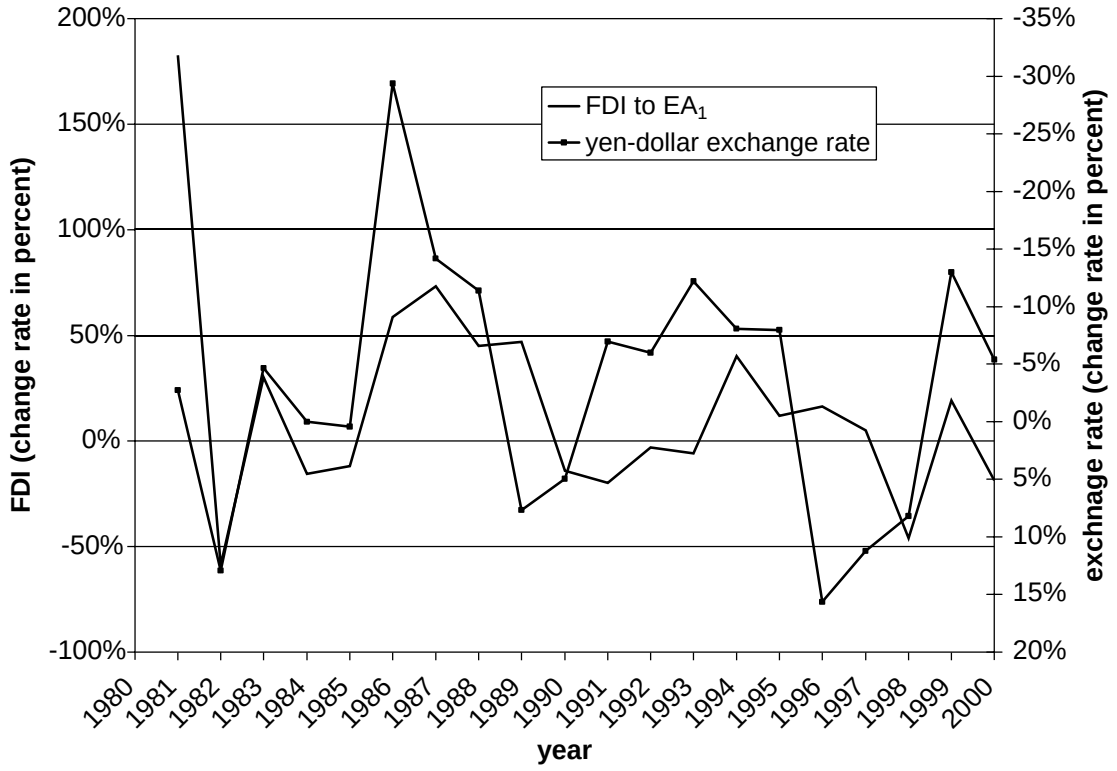
Source: IMF: IFS. Volatility defined as monthly percentage change rate.

Figure 4. East Asian (EA_1) Exports and the Yen/Dollar Exchange Rate, 1980-2000 (Yearly)



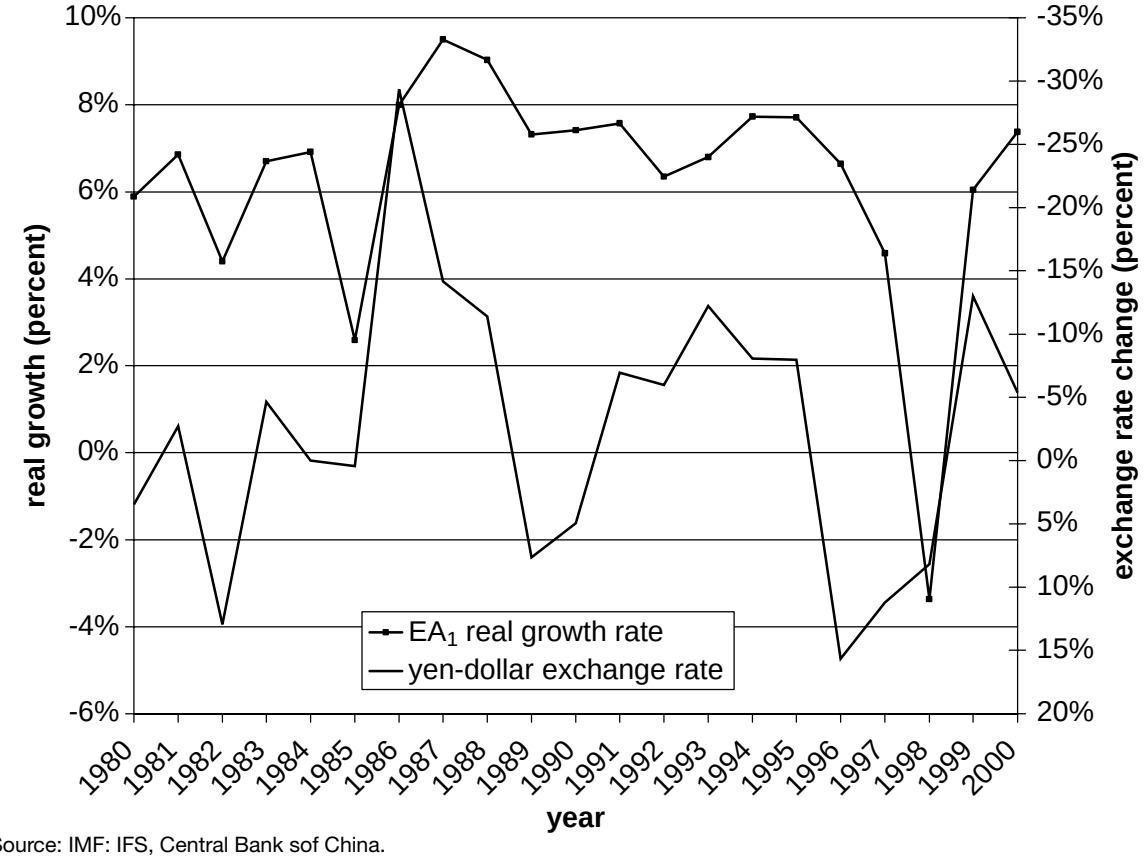
Source: IMF: IFS. Note: EA_1 exports only excluding China and Japan.

Figure 5. Japanese Foreign Direct Investment to East Asia (EA_1) and the Yen/Dollar Exchange Rate, 1980-2000 (Yearly)



Source: Japan: Ministry of Finance and IMF: IFS.

Figure 6. The East Asian (EA_1) Business Cycle and the Yen/Dollar Exchange Rate, 1980-2000 (Yearly)



Source: IMF: IFS, Central Bank sof China.