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ECONOMIC GROWTH AND REAL EXCHANGE RATE: AN OVERVIEW OF THE BALASSA-SAMUELSON HYPOTHESIS IN ASIA

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ABSTRACT

The paper tests the Balassa-Samuelson hypothesis (rapid economic growth is accompanied by real exchange rate appreciation because of differential productivity growth between tradable and nontradable sectors) using data of the APEC economies. Japan, Korea, Taiwan and, to a lesser extent, Hong Kong and Singapore, were proved to follow the Balassa-Samuelson path. These countries follow a similar industrialization pattern, increasing the weight of high value-added exports. Although Hong Kong and Singapore grew fast, their real exchange rates appreciated only moderately. High productivity growth in service sectors might have been the reason for this. Other fast-growing ASEAN countries, such as Thailand, Indonesia and Malaysia did not experience real appreciation. Closer examinations of various components of the Balassa-Samuelson hypothesis revealed that key assumptions are not uniformly supported: There is no uniform pattern for the movement of nontradable prices relative to tradable prices; and tradable prices (measured by common currency) do not show the international arbitrage.

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1. Introduction

The relationship between the exchange rate and economic development is certainly an important subject, both from the positive (descriptive) and normative (policy prescription) perspectives. Several developing countries, that have implicitly or explicitly fixed their exchange rates to the currency of another country (say, the US dollar) with their inflation rates being higher than that of the foreign country (the U.S), often experience persistent current account deficits and an eventual devaluation of the currency. The devaluation often invites a recession and inflation, thus push the economy into an inflation-devaluation spiral, causing a serious set-back in economic development. There are other developing countries that grow exceptionally fast and often face an opposite pressure on their currencies. A high economic growth rate is most likely accompanied by high investment rate, and high export growth as well. The successful exports produce current account surpluses, resulting in a *nominal* appreciation pressure on the currency, unless the central bank intervenes in the foreign exchange market and accumulates foreign reserves. Even if the intervention maintains the fixed exchange rate, unsterilized intervention results in inflation and the *real* exchange rate appreciates anyway. In the world of free capital mobility, another channel for an appreciation exists. Fast growth often invites inflows of foreign capital. Some investors in industrial countries pursue high returns (even with high risk) as part of a diversified portfolio. Capital inflows put pressure on the (nominal) exchange rate to appreciate. For example, demand for the currency of the emerging market will rise when foreign investors plan to purchase bonds and stocks, as the local currency has to be obtained first. Put simply, successful economic development results in a currency appreciation with improvement in the standard of living, while a failure in economic development often results in a sharp currency depreciation.

One of the most popular hypotheses with respect to long-term real exchange rate movement is the so-called Balassa-Samuelson (BS) hypothesis, which conjectures that productivity increases in the tradable sector (T-sector) tend to be higher than those in the nontradable sectors (N-sector), so that the conventionally constructed real exchange rate (using a price index including both T-sector prices and N-sector prices, such as CPI, or GDP deflator) will move reflecting the cross-country differences in the relative speed of productivity increases between the T-sector and N-sector.[2] Since the differences in productivity increases are expected to be larger in high growth countries, the BS prediction should be most visible among rapidly growing countries. It is well known in the literature that the postwar Japanese record has been a prime example of the BS hypothesis. However, just one country does not prove the case. Hence, the Asian emerging markets with high growth rates seem to offer a good testing ground. A few additional thoughts and regressions are also shown and interpreted.

Although the BS hypothesis makes a prediction on the movement of the real exchange rate based on the common pattern (T-sector productivity growth is higher than N-sector) among high growth countries, the original mechanism for high growth is not explained. The present paper examines why some countries grow faster and whether the mechanism for high growth makes a difference in proving or refuting the BS hypothesis.

Japan and other high growth countries in East Asia have completed, or have been experiencing, a transformation from an agricultural, stagnant economy to a manufacturing, export-oriented, growing economy. The success is based on the change in industrial structure, gradually moving up a technological ladder. In many countries, economic development changed the structure from low value-added-goods sectors, such as primary goods and textiles, to high value-added-goods

sectors, such as manufacturing and machinery, sectors. Moreover, each sector changes its trade status from a net importer to domestically self-sufficient, to a net exporter. The important element of economic development in Asia seems to be a constant upgrading (high quality and more sophisticated products) of the industrial structure and exporting goods. This observation is sometimes nicknamed a "flying-geese pattern" of economic development.[3] Its original meaning was that a particular manufacturing sector, such as the steel industry in Japan, experiences stages from an import surge to a domestic production surge replacing imports, to an export surge; and then the same pattern is repeated in the industry next up in the sophistication ladder, say the automobile industry. The more recent, popularized version of the flying-geese pattern is that Asian countries experience the same pattern of industrial development but with time lag. At a particular point of time, Japan is a leader followed by Singapore and Hong Kong, which are followed by Korea and Taiwan, and then by Thailand and Indonesia, etc. We will make observations on the relationship between the BS hypothesis and the flying geese hypothesis below.

The rest of this paper is organized as follows. In section 2, relationship between the changes in the real exchange rates and growth rates among East Asian countries is reviewed. Section 3 examines the relationship between the machinery exports and growth. Section 4 examines a relationship between export characteristics and growth, and another between export characteristics and real exchange rate changes. Section 5 examines the link between the Balassa-Samuelson hypothesis and stages of economic development. The link between productivity growth and the relative price changes, one of the important links in the Balassa-Samuelson hypothesis, is examined in Section 6 using sectoral data of Japan and the United States from 1960 to 1992.

2. Stylized Fact of the Balassa-Samuelson in APEC

For testing the Balassa-Samuelson hypothesis, the relationship between the growth rate and the change in the real exchange rate is examined. The Asia-Pacific Economic Cooperation Council (APEC) countries and economies are taken as an example here. Since economic development stages are diversely different among APEC countries, the examination will be a good test of how universal the Balassa-Samuelson hypothesis would apply.

In notation, growth rate and the real exchange rate change are defined as follows. The growth rate denoted by **dG(j, t+k)** is the average per capita GDP growth rate of country j between t and t+k.

$$Y(j, t+k) = (1 + \mathbf{dG(j,t+k)})^k \, Y(j,t),$$

where Y(j,t) is per capita GDP of country j in year t. The growth rate relative to the United States is the difference between dG(j) and dG(US). Let us denote by S(j,t) the nominal exchange rate of country j in year t, in the unit of the value of country j's currency in terms of US dollar, e.g., $/Yen, for Japan; P(j,t) is the GDP deflator of country t, P(*,t) is the GDP deflator of the United States. Namely, the (average compound) change in the real exchange rate Q of country j, **dQ(j,t+k)**, for k years, is defined in the equation,

$$Q(j, t+k) = (1 + \mathbf{dQ(j,t+k)})^k \, Q(j,t),$$

where $Q(j,t) = S(j,t)P(j,t)/P(*,t)$. If, dQ(.) is positive, it means that the currency of country j is appreciating in the real exchange rate.

Figure 1 shows the relationship between the economic growth rate and the change in real exchange rate for the APEC countries for the period from 1973 to 1995 (except for Chile where the sample is from 1975 to 1995).[4] The positive relationship between economic growth and the real appreciation, that is a hallmark of the Balassa-Samuelson hypothesis, is found in Japan, among the

four "tigers," or the newly industrialized economies (NIEs), and, to a much lesser extent, in Chile. One can also point out that the positive correlation was found in two other countries, Mexico and Papua New Guinea (PNG) in terms of negative growth (again relative to the United States) and depreciation (negative appreciation). However, not all APEC countries experienced the positive correlation between growth and real appreciation. Australia, Canada, New Zealand, and Philippines experienced growth rates similar to the United States (within one percentage point) with little depreciation or appreciation. Indonesia, Thailand, and Malaysia experienced high growth with real depreciation, although the magnitude of depreciation was small.

China, another high growth country, experienced a large depreciation, thus appearing to violate the BS prediction. China's depreciation can be understood as an "outlier," in that the country rapidly transformed form a closed, planned economy to an open economy in the last half of the sample period. The opening also meant correction of the overvalued exchange rate. In a sense, depreciation was necessary in order to compete in the global markets. In a sense, large depreciation preceded high growth rates, but both are included in the sample period. This kind of drastic economic reform is not considered in the Balassa-Samuelson theory.

As shown in **Table 1**, a simple regression produces an insignificant coefficient of the growth rate, while a regression excluding China would yields a growth coefficient significant at the 2 percent level. A possible justification for excluding China from the sample, as suggested above, is that China had maintained strict trade and exchange controls in the 1970s and the 1980s. Although the regression has too small samples to make a general statement, it can be said that the Balassa-Samuelson hypothesis is in general supported by the APEC findings.

In summary, Figure 1 and Table 1 indicate that the high growth economies in East Asia

generally experience high growth and real appreciation in the period from 1973 to 1995. The finding is consistent with the Balassa-Samuelson hypothesis. Although it is difficult to generalize the finding to other APEC members, the gross violation to the hypothesis is limited to China, which had the unusual economic transformation from a planned economy to a market economy during the period.

3. Export-led Growth

In the theoretical Balassa-Samuelson framework, growth is exogenously given to the economy. How tradable and nontradable sectors differ in productivity growth is not explained in the model. However, theory hypothesizes and predicts how they collectively contribute to the overall growth and change of relative prices, given growth in different sectors.

The Balassa-Samuelson theory is also different from some of the often-heard advice in that in order to promote growth, depreciation must be induced. If that was a predominant phenomenon for promotion of high economic growth, we would have found a negative correlation between growth and real appreciation for many countries (not just for China).

In order to shed some light on where growth comes from, our next task is to investigate the source of growth and its relationship to the real exchange rate behavior. Many works, for example World Bank (1993), emphasize the importance of exports in achieving sustained growth. In addition, a hypothesis which is often emphasized in development economics is that the industrial and export structures have to change to make it possible to grow fast for a sustained period. As the economy grows, there is a limit to how much a single kind of product, say textiles, can be exported to the global market, even if the economy becomes better at producing the products. Sooner or later, the comparative advantage of the industry is eroded either by political resistance to rapidly increasing imports in destination countries or by wage hikes at home. With improved skills and work ethics

among workers, the next-level industry, say machinery, would be ready to take off. The change in the structure of exports is one of the important aspects of economic development and a high rate of economic growth. A proxy variable for development of high-value-added manufactured goods is needed for quantitative examinations. Here, the ratio of machine exports (values) to total exports (value), denoted by M(j, t), is chosen as an indicator for structural changes. Then its change from 1973 to 1992, denoted by dM(j,t+k), is defined as,

$$dM(j, t+k) = M(j, t+k) - M(j,t) .$$

The growth rate, as defined above, dG, is expected to be closely related to the export structural change. **Figure 2** shows the relationship between the per capital growth rate and the change in the machines export ratio from 1973 to 1992 (the last year that the data for export ratios are available). The rise in manufacturing sector in output and exports is one of the conditions for a spurt in growth. The figure shows a positive relationship between the increase in the machines export and the growth rate. Korea, Taiwan, Singapore, Malaysia, Thailand, and Japan show the strong correlation between the machine export ratio and growth. These countries are often referred to as a group of countries where exports are an engine of growth.

Hong Kong and Indonesia, experienced only a mild increase in the machine export ratio. China achieved high economic growth without a visible change in machine exports. The Western Hemisphere countries also show a positive relationship between a moderate increase in machine export ratio and a moderate growth. Advanced countries like, the United States and Japan have already achieved high levels of machine export ratio, so that it would not be possible to produce a high increase in the ratio.

The regression analysis reported in **Table 2** supports, although with weak statistical

significance, the casual observation of the positive relationship observed in the figure. More machine exports have been important in achieving high economic growth in many East Asian countries. This is consistent with the conventional wisdom (in the literature explaining Asian growth) that for high-speed growth, the shift in export items is to high-value-added, manufactured goods.

The coefficient implies that a 10 percentage point rise in machine exports ratio to total exports increases the growth rate by 0.8 percentage point, over the "natural" growth rate of 2.23 percent. Although the regression is very simple, it accords with a popular belief in the importance of structural changes in boosting the growth rate "temporarily" (for a decade or two) before it comes down. The machine export ratio is bounded by unity, so that the exceptional growth cannot continue.

Suppose that the trade structural change, either policy driven or market driven, is the exogenous engine that pushes the economy to grow fast. The increasing share of machines in exports can be interpreted as the faster productive growth in the tradable sector, one of the assumptions of the Balassa-Samuelson mechanism. In this interpretation, both per capita growth and real exchange appreciation are the results of fundamental structural change. According to this interpretation, in explaining the real exchange rate change, it would be more appropriate to regress the change in the increase in the machine export ratio than economic growth.

Figure 3 shows the relationship between the machine export ratio and the real exchange rate change from 1973 to 1992, the relationship of another pair of variables from Figures 1 and 2. Among the Asian high growth countries, Korea, Taiwan, and Japan show strong gains in the machine export ratio and real exchange rate. Hong Kong is now in line with the group of Korea and Taiwan in the sense that it has only moderate gains in the machine export ratio and real exchange rate. Singapore and Malaysia remain a puzzle to the Flying Geese and Balassa-Samuelson hypotheses believer: despite

a large gain in the machine export ratio, the real exchange rate has not appreciated. Thailand and Philippines also advanced in machine export ratio, without real appreciation. China and Chile again are outliers with large real exchange rate depreciation.

Table 3 shows that when the real exchange rate change is regressed on the change in machine export ratio, the coefficient is positive and significant (at 10 percent significance level).

In summary, Figures 2 and 3 show that the trade structure change influences both the growth rate and the real exchange rate. Evidence in these figures is consistent with a hypothesis that the economic transformation to high-value-added industries is a key to economic growth with real exchange rate appreciation. Advances in productivities and competitiveness in the high-value-added, tradable sectors (here proxied by the machine export ratio) are consistent with both the positive correlation between growth rates and real appreciation and the basic premise of economic development with industrial transformation.

4. Examination of the Balassa-Samuelson Hypothesis

In this section, some of the basic assumptions for the Balassa-Samuelson hypothesis are examined to confirm how it works for Japan and the NIEs and how it does not necessarily work for other countries (especially ASEAN countries).[5]

In the Balassa-Samuelson hypothesis, high economic growth is made possible by high productivity growth, with differential sectoral growth rates that cause the inflation differentials among different sectors. The relative price of nontradable (N-) goods to tradable (T-) goods is expected to rise faster in countries with faster growth, since the differential in inflation rates have to widen to make the overall growth rate higher. Combining this with the assumption that the prices of tradable

goods are equalized across countries, the real currency appreciation of the countries with high growth is derived. In a schematic way, the Balassa-Samuelson hypothesis can be decomposed into four steps.

(A1) The differential in productivity growth rates between T- and N-sectors cause relative prices changes.

(A2) The ratio of (N-prices) to (T-prices) becomes higher in a faster growing economy;

(A3) Ratio of the T-sector prices across countries remain constant (or in the special casem the T-sector prices across countries are equalized); and

(A4) A combination of (A2) and (A3) causes real exchange rate appreciation.

In the rest of this section, we investigate whether the relationship between growth and the relative price would hold and whether the T-sector price equality would hold. In order to do this, the decomposition of real appreciation is helpful. Let us denote the broad price index of country j by P(j). The price index could be the GDP deflator or the CPI index. The price index is composed of non-tradable prices, P_N, and tradable-goods prices, P_T. The weight of nontradable goods is n. Therefore,

$$P(j) = n(j)\, P_N(j) + (1-n(j))\, P_T(j), \qquad (1)$$

Similarly for the world prices denoted by asterisk:

$$P^* = n^*\, P^*_N + (1-n^*)P^*_T \qquad (2)$$

Here they are prices in the United States. Let us denote the ratio of common-currency prices of tradables by b, which, according to (A3), is supposed to stay constant:

$$b(j) = S(j)P_T(j)/P^*_T.$$

Then,

$$Q(j) = S(j)P(j)/P^* = b(j)\,[(1-n(j)) + n(j)(P_N(j)/P_T(j))] \,/\, [(1-n^*) + n^*(P^*_N/P^*_T)] \qquad (3)$$

This equation decomposes the real exchange rate into four primary components:

b(j): the ratio of common currency prices of tradables

$P_N(j)/P_T(j)$: the relative non-tradable prices of country j

P^*_N/P^*_T: the relative non-tradable prices of the benchmark country

n and n*: The weight of the nontradable sectors in the overall price index

As mentioned above, the Balassa-Samuelson hypothesis assumed that b stays constant, or the law of one price for tradables. Then for countries other than the benchmark country (the United States, for which P^*_N/P^*_T is given) the higher the relative price of nontradable goods, $P_N(j)/P_T(j)$, the higher the real exchange rate would become.

The first issue in estimating the relative nontradable prices is to identify the sectors that can be regarded as "nontradable" and "tradable." Here, manufacturing is assumed as "tradable" and service as "nontradable." The prices are recovered as unit value from nominal and real series of these sectors.[6]

Figure 4 shows the relationship between the relative per capita GDP growth (as in Figure 1) and the change in the nontradable-tradable price ratios. Both variables are measured in relative to the benchmark of the United States. Due to the availability of the relative price date, the sample periods slightly vary for different countries. If differential productivity growth rates between nontradable secotra and tradable sectors are the source of both high income growth and the inflation differentials between the two sectors, there should exist a positive correlation between the change in nontradable-tradable prices and the income growth. However, Figure does not show such a correlation. Although some difficulties exist in correspondence from theory to data, such as the

precise differentiation bewteen tradable and nontradable sectors in data, the evidence in this figure does not support the logic of the Balassa-Samuelson hypothesis.

Figure 4 also shows that several fast growing Asian countries, namely Thailand, Hong Kong, Malaysia, and Singapore, have not experienced the rise in the relative price of nontradables (in relative to the United States), while other countries, Korea, China, Taiwan, Indonesia and Japan, show a positive correlation between growth and the change in the nontradable-tradable price ratio (both in relative to the United States). Other slow growth countries do not show any patterns on this relationship. As long as the United States is taken as a benchmark, a causality link from growth to relative nontradable prices is not confirmed.

Figure 5 shows the relationship between the changes in the ratio of common currency tradable prices and the real exchange rate. The vertical axis is the same as Figure 1, the change in the real exchange rate (vis-à-vis the United States, using the GDP deflator). The horizontal axis is the change in the tradable prices (vis-à-vis those of the United States). This is an investigation whether assumption (A3) holds. Assumption (A3) states that the ratio of the tradable prices across country remains the same (in other words, the "relative" PPP in tradables), implying b(j) should be constant for all time periods, so that all the countries should cluster around the vertical line at zero However, evidence shows that many countries experienced a sustained change in tradables prices vis-à-vis the U.S tradable prices, or the deviation from the vertical axis at tradable prices change equals zero. In many countries (in southeast quadrant of the figure), the movement of tradable prices (increase) is opposite to the real exchange rate changes, in contrast to the partial correlation suggested by equation (3). Other countries (Korea, Japan, Mexico, Singapore, Australia, Indonesia), the overall correlation has the same sign as to partial correlation. Both Korea and Japan experienced high real

exchange rate appreciation. However, Korea seems to be consistent with the Balassa-Samuelson hypothesis (near the vertical axis, namely the relative PPP in tradables), while Japan seems to have experienced the deviation from it. Again, evidence in Figure 5 did not generally support one of the basic assumptions that lie behind the Balassa-Samuelson hypothesis.

In order to quantify the contribution of the different components of the real exchange rate changes as depicted in equation (3), the decomposition of the changes are shown in **Table 4**. The proximate determinants of real exchange rate are calculated. The table quantifies what we have learned from the series of Figures. In this table, the real exchange rate is calculated based on the GDP deflator but as if the GDP consists only of the output of the manufacturing and service sectors. The table shows that proximate causes of reasons for real exchange rate changes are quite different from country to country. Among high growth Asian countries, only Japan, Korea, and Singapore had real exchange rate appreciation (with Hong Kong and Taiwan omitted due to unavailability of data). Singapore observed a wrong (from the BS point of view) direction in the change in the relative non-tradable prices. Some typology emerges from the above observations. The next section provides a summary on the applicability of the Balassa-Samuelson effect on each country in the Asian region, and, if non-applicable, reasons for the deviation. (All the comparative statements are vis-à-vis the United States.)

In summary, we have two ways to interpret rather disappointing findings in Figures 4 and 5 and to reconcile them with more positive findings in Figure 1. One interpretation is that as assumptions that comprise the Balassa-Samuelson hypothesis are not verified, the validity of the hypothesis itself is questioned. Another interpretation is that the Balassa-Samuelson hypothesis is basically confirmed as shown in Figure 1, but examinations of each component of the hypothesis is

not practically possible, because, for example, the differentiation between tradable and non-tradable sectors is hardly possible in available data.

5. Balassa-Samuelson Effects with Stages of economic Development

Japan is known to be a country that conforms with the Balassa-Samuelson prediction, namely the positive correlation between economic growth and real exchange rate appreciation, in the literature. Figure 1 also showed that Korea and Taiwan, and to a lesser extent, Hong Kong and Singapore, experienced a strong real appreciation with growth. However, examining closely how assumptions for the Balassa-Samuelson prediction hold up in data, careful statements are needed. In the Korean case, tradable prices did not rise but non-tradable prices rose sharply, consistent with the Balassa-Samuelson assumptions, while Japan experienced both tradable and nontradable prices rose vis-a-vis the United States, while the nontradable prices rose much more than the tradable prices. Machine exports rose for Korea, suggesting that the high-value-added exports have been the engine of rapid growth. In Singapore, although tradable prices rose slightly, nontradable prices rose less than tradable prices. Both Hong Kong and Singapore thrive on entrepôt trade and financial services (nontradables), and, more recently, on financial services. At this point, our data are so coarsely aggregated that it is difficult to make a judgement, but it is possible that the service sector experienced productivity increases as fast as tradables, so that relative prices between the two sectors do not follow the traditional logic of the Balassa-Samuelson hypothesis.

There is a group of countries that contradicts the Balassa-Samuelson hypothesis; namely, the real exchange rate depreciated rather than appreciated while economic growth took place. The Balassa-Samuelson hypothesis does not explain the real exchange rate behavior of Thailand and

Malaysia, either. The real exchange rates of these countries were maintained relatively stable. The nontradable prices (relative to tradable prices) did not change much, or even slightly declined, in contradiction to the assumption (A2). The fact that Thailand, Malaysia, and Indonesia managed to have kept the real exchange rate more or less constant, as the economy grew fast, is not well explained. All three countries have traditionally had strong primary goods exports: Thailand, food; Malaysia, primary goods; Indonesia, oil. Industrialization has changed their export structures quickly, especially in Thailand and Malaysia. In both Thailand and Malaysia, the machines export ratio rose at a moderate pace. Although these countries are also a prime example of how growth can be achieved by moving the export structure to more high-value-added products, it is somewhat puzzling why nontradable prices are not rising in these countries.

The Philippines provides an even stronger contradiction of (A2) in which the tradable prices rose relative to nontradable goods. Philippines was a country that did not share a benefit of high growth in the region. The growth rate remained low. The nominal exchange rate depreciated as general inflation was higher than the U.S., and the real exchange rate was kept more or less constant. However, with tradables prices rising in relative to nontradables prices, the price advantage in exports has been lost.

China experienced the largest real depreciation in our samples, while economic growth was respectably high. The primary reason for the real depreciation was the large nominal exchange rate depreciation after 1979. We should note that both the trade and capital account restrictions were rather tight in China during most of the sample period. At the initial point of our sample (in 1973) the exchange rate of China was probably overvalued, but large current account deficits did not occur only because of high tariffs and trade restrictions. The change in policy in the late 1980s allowed the

decrease in dollar-value tradable prices and depreciation in the nominal exchange rate, both of which promoted exports and growth. The foreign exchange restrictions on current account transactions remained imposed in China for the entire period of our samples, while other developing countries in our sample lifted restrictions sometime in the 1980s.[7]

It is quite likely that a country that moves from a closed-economy policy to open, growth-oriented policy must depreciate the currency before opening the economy. In this case, the real depreciation is not the result of economic growth, but a precondition for trade-oriented growth. The findings above support a view that China, 1973-1992, is one of such successful cases. According to this view, China depreciated the currency (toward equilibrium) to promote exports, which resulted in growth. Since the machine export ratio did not rise (Figure 2), the export increase came mostly from price competitiveness, and not from the trade compositional shift to the high-value-added products. Indonesia may be similar to China, in that the nominal exchange rate had depreciated, as the economy grew. Both the dollar-value tradable and nontradable prices had declined (thus promoting exports and growth). Since Indonesia's machine export ratio did not rise (Figure 2), the export increase came mostly from price competitiveness, and not from the trade compositional shift to the high-value-added products.

The above examinations suggest that there are at least three ways that Balassa-Samuelson's basic assumptions can be violated. First, the relative tradable prices across countries may not stay constant. When industrial and export structures are changing fast, not only relative prices but the composition among tradables are changing. Tradable prices may appear to rise when the composition of domestic products as well as exports move to high-value-added goods. Assumption (A2) still holds if nontradable prices increase much faster than tradable prices. Second, the ratio of nontradable

prices to tradable prices may not behave as Balassa and Samuelson postulated. In some economies nontradable sectors, especially financial services, increased the productivity. Third, trade restrictions and foreign exchange rate restrictions may prevent both economic growth and adjustment of prices and the exchange rate to reflect competitiveness of the industries. Economic reform often produces large depreciation to kick start growth. High growth follows large depreciation, apparently violating the Balassa-Samuelson hypothesis.

The following summary based on the development stages is consistent with apparently conflicting pieces of evidence presented above. When the economy first opens up (to market mechanism and to trade), it often needs real depreciaiton in order to eliminate import barriers and promote exports. If reforms are successful, data would show that the economy experiences both growth and real depreciation. In the initial stage of industrialization, both nontradable and tradable prices may stay relatively stable, since labor shift from the surplus sectors (often agriculture) to booming sectors cancells out any inflation pressure. However, as the economy moves into a stage of producing sophisticated goods with limited supply of labor, the relative price movements reflect productivity differentials among different sectors. Sophistication of the economic progress, for example proxied by the machine exports ratio, can be correlated with growth and real appreciation. As there are diverse economies in the APEC group, the picture we obtain from APEC (for example Figure 1) is a mix of different combinations of growth and real exchange rate changes.

6. Productivity Increase and Relative Price Changes

The key observation of the Balassa-Samuelson hypothesis is that productivities grow at different rates among different sectors and countries. As technological progress tends to occur in

manufacturing sectors and other tradable goods sector, a country can achieve higher overall economic growth by increasing the difference between productivities of tradable sectors and those of nontradable sectors. The productivity differential results in the relative price changes. The link from productivities to relative price changes was not tested in this paper, because it is often difficult to obtain reliable data on sectoral productivities in developing countries. In this section, as an example, the sectoral (labor) productivities and sectoral (GDP) deflators are examined for Japan and the United States using OECD sectoral output data from 1961 to 1992.

Figures 6 and 7 show the correlation between changes in labor productivities and relative price changes of different sectors in Japan and the United States, respectively.[8] The figures clearly show the negative correlation between the productivity increase and price inflation among different sectors in both countries. In each country, the manufacturing sector has achieved the highest (or the close second in the U.S.) productivity increases and the lowest inflation. The agriculture industry, as well as Energy and Transport industry, is better than average in both countries. Typical nontradable industries, such as service and contruction, achieved only low productivity increases (or negative in the U.S.) and very high inflation. Hence the link between the productivity increase and sectoral infaltion is clearly shown.

Comparing Japan and the United States, tradable sectors in Japan had much faster productivity growth, thus raising the overall growth rate, than the United States. The low inflation in the manufacturing sector also contributed to the low price increases among the tradables in Japan in realtive to the United States. These figures clearly show that assumption (A1) -- the larger the productivity difference between tradable and nontradable sectors, the larger the inflation differential -- was a reasonable one at least in Japan and the United States, and also in the comparison of the two

countries.

7. Concluding Remarks

The typology and evidence in the previous sections showed some evidence of applicability of the Balassa-Samuelson hypothesis to high growth countries in Asia, although violations were also evident. The Balassa-Samuelson effect is found to be most prominent in Japan, Korea and Taiwan, resourceless economies that transformed from an agricultural state, to light industrial goods (e.g., textile) exporters, to heavy industrial goods exporters. As trade was promoted, the nontradable goods became relatively expensive. The subsequent analysis showed that there are at least three ways to violate of the logic of the hypothesis, the nontradable prices in relative to tradable prices may not rise as the economy grows; the tradable prices, measured in US dollars, may deviate from the tradable prices in the US; and economic reforms may cause the negative correlation between growth and real appreciation.

The paper suggests that the applicability of the Balassa-Samuelson hypothesis to a particular economy is subject to the development stage of the economy. It is especially applicable when a resourceless, open economy is growing fast by changing industrial and export structures. Even if the economy is growing fast, it may not be applicable to the economy which has just come out of the low, primary goods export or out of the planned economy. It is possible, however, that for these countries, a further development of the economy will result in the real appreciation in the future.

APPENDIX

APEC economies membership list and acronyms used in the figures

Asian countries

Acronym	
JPN	Japan
KOR	Republic of Korea
TWN	Taiwan (Taiwan Province of China according to the IMF convention; and Chinese Taipei in the APEC membership list)
HKG	Hong Kong
SGP	Singapore
CHN	People's Republic of China
IDN	Indonesia
MYS	Malaysia
PHL	Philippines
THA	Thailand
BRU	Brunei Darussalam

Western Hemisphere

USA	United States of America
CAN	Canada
MEX	Mexico
CHL	Chile

Oceania

AUS	Australia
NZL	New Zealand
PNG	Papua New Guinea

Data Description

GDP per capita growth rate
Definition. The real GDP is devided by population. An average change (growth rate) is defined in a compound rate for a specified period.
Source: International Monetary Fund, International Financial Statistics (IFS).

Nominal exchange rate and Real exchange rate
Definition. The nominal exchange rate is defined as the local currency value in terms of the U.S> dollar. The real exchange rate is defined as the bilateral exchange rate, vis-a-vis the United States, adjusted to the difference in the GDP deflators of the country and the United States. An average change for a period is defined as a compound rate for the period.
Source: IFS.

Machine Export Ratio
Definition. Machine exports (value) divided by total exports (value).
Source: World Bank, World Data.

Nontradable/Tradable price Ratio (PnPt ratio) and Tradable Prices
Definitions: The tradable prices (Pt) index is the GDP deflator for manufacturing sector, and the nontradables index (Pn) is the weighted average of the GDP deflators for other sectors. The relative PnPt ratio for country j vis-a-vis US was calculated as
$P(j) = (Pn(j)/Pt(j))/(Pn(US)/Pt(US))$
Data Source: For industrial countries, OECD, National Accounts, vol. 2, Detailed Tables, various issues. For developing countries, World Bank, data bank NA.

Exceptions are as follows: (i) Data Hong Kong are not reported in the above source. The PnPt ratio for Hong Kong is constracted by Baekin Cha from Hong Kong disaggregated consumer index, CPI (A) series. The nontradables categories are housing, transport and miscellaneous services. The tradable categories are all others, including clothing and footwear, durable goods, food, fuel and light, miscellaneous goods, alcoholic drinks and tobacco. The index is constructed from 1975 to 1995. (ii) Data of Taiwan are not reported in the above source. The PnPt ratio for Taiwan is constracted by Kenneth Lin from Taiwan National Income Accounts. The tradable prices are a weighted average of GDP deflators for agricultrue and fishing, quarrying, and manufacturing, while the nontradable prices are a weighted average of GDP deflators for utilities, construction, commerce, transport and communications, financial and business services and other services.

Notes:

1. The authors are at the International Monetary Fund. Any views expressed here are those of the authors and not those of the institutions with which they are or have been affiliated. Part of this paper is based on Ito, Isard, Symansky and Bayoumi (1996) that was conducted at the request of the APEC Finance Ministers.

2. The original articles are Balassa (1964) and Samuelson (1964). For recent studies, see Asea and Mendoza (1994), De Gregorio and Wolf (1994), De Gregorio, Giovannini, and Wolf (1994), Marston (1990), and Corden (1960).

3. See Ito (1995) for this hypothesis. For traditional economic development theory, see for example, Kuznets (1959, 1971).

4. For data source, see Ito, Isard, Symansky and Bayoumi (1996). For this paper, the data are updated to 1995. In our earlier work, the magnitude of real appreciation in Hong Kong and Singapore was smaller. Some possible causes for the result was discussed. The real appreciation in the updating years made them comparable to Taiwan. Although Young (1992) emphasizes the difference in the investment and growth pattern between the two city states, they look very similar in the real exchange rate performance in the framework of the Balassa-Samuelson hypothesis.

5. This section is largely based on Isard (1995) and IMF (1996; chapter 2).

6. For developing countries, the data set used in this analysis is the World Bank, Economic and Social Database, while for industrial countries, the data set is from the OECD.

7. Liberalized foreign exchange controls on the current account transactions and accepted the IMF Article VIII in December 1996.

8. The data come from OECD, National Accounts, volume 2, various issues. The tables that correspond to these figures are also shown in Ito (1996; table 2).

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Table 1, $dQ(j, t+k) = a + b\, dG(j, t+k)$			
All samples	a	b	R bar sq.
coefficient (t-statistics)	-0.167 (-0.322)	0.181 (1.070)	0.01
All but CHN	a	b	R bar sq.
coefficient (t-statistics)	-0.236 (0.357)	0.357 (2.664)	0.29

Table 2, $dG(j, t+k) = a + b\, dM(j, t+k)$

Sample period: 1973-92.

All samples	a	b	R bar sq.
coefficient (t-statistics)	2.234 (2.59)	8.431 (1.657)	0.098

Table 3, $dQ(j, t+k) = a + b\, dM(j, t+k)$			
All samples	a	b	R bar sq.
coefficient (t-statistics)	-1.373 (-1.827)	0.752 (1.892)	0.139

Table 4: Changes in Real Exchange Rates and Proximate Determinants, 1973 - 1992

	Q	b	n	P_N / P_T
Australia	-20.9	-18.7	2.9	-4.8
Canada	-0.6	16.2	7.0	-20.4
Chile	-32.7	-13.8	0.1	-29.0
China	-74.5	-77.7	-27.6	46.0
Indonesia	-35.9	-35.3	-23.8	-4.3
Japan	36.8	27.8	-7.7	17.0
Korea	62.9	3.8	-27.0	86.0
Malaysia	-16.4	1.1	-6.4	-23.6
Mexico	11.0	15.5	-7.7	-6.3
New Zealand	23.3	21.6	-1.8	1.5
Papua New Guinea	-22.7	6.6	-0.7	-34.3
Philippines	15.8	36.0	6.2	-20.6
Singapore	8.6	59.4	-1.5	-41.8
Thailand	-1.8	11.3	-17.9	-15.2

Notes. 1. Determinants n and P_N/P_T are measured as ratios to U.S. levels.
2. The years for samples are different for the following countries: Canada, 1971 - 1990; Chile, 1977 - 1992; New Zealand, 1977 - 1990; Papua New Guinea, 1980 -1992; Chile, 1973 - 1988; and Malaysia, 1973 - 1983.
Source: Ito, Isard, Symansky, and Bayoumi (1996)

Figure 1

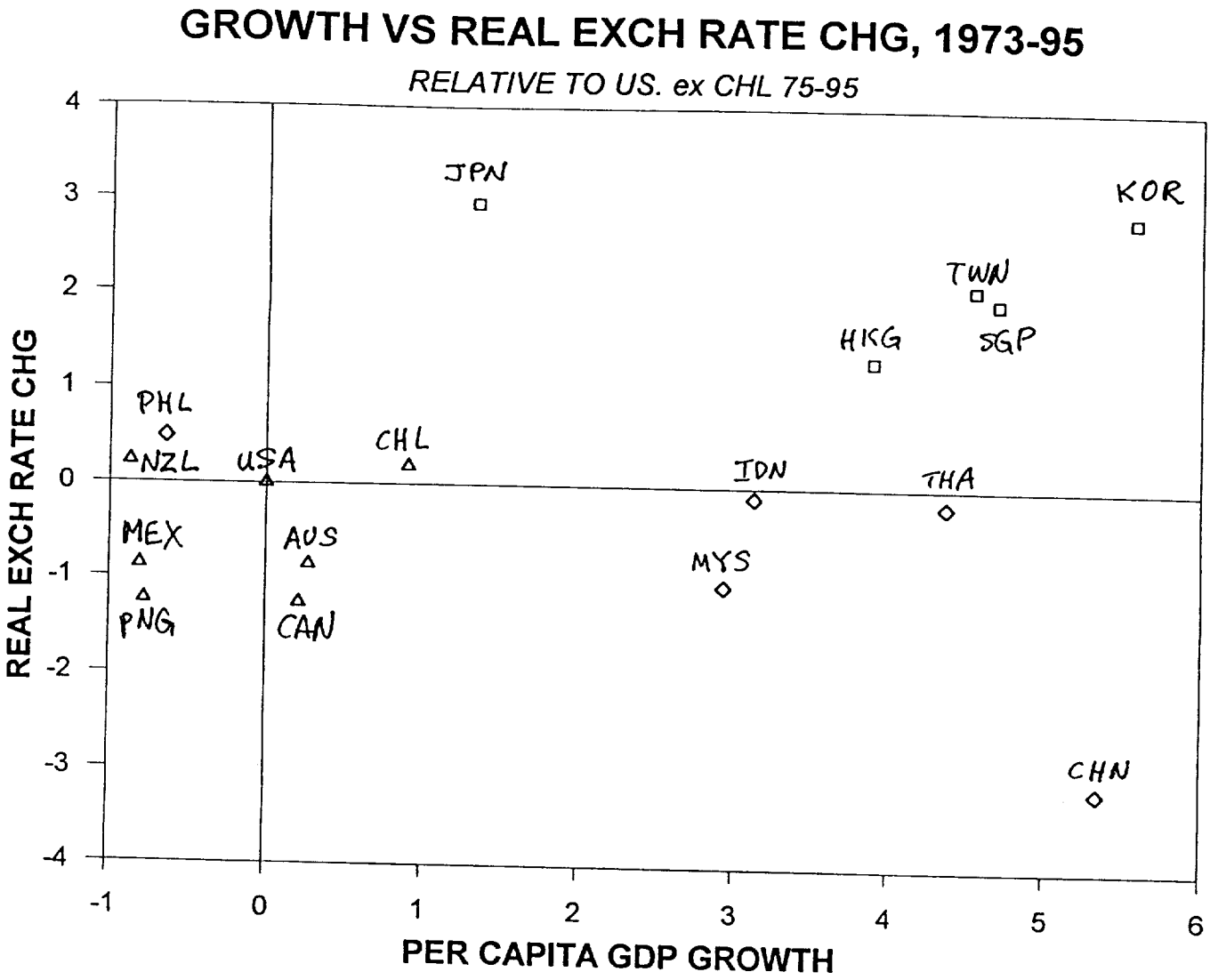

GROWTH VS REAL EXCH RATE CHG, 1973-95
RELATIVE TO US. ex CHL 75-95
REAL EXCH RATE CHG
PER CAPITA GDP GROWTH
4
3
2
1
0
-1
-2
-3
-4
-1
0
1
2
3
4
5
6
JPN
KOR
TWN
HKG
SGP
PHL
NZL
USA
CHL
IDN
THA
MEX
AUS
MYS
PNG
CAN
CHN

Figure 2

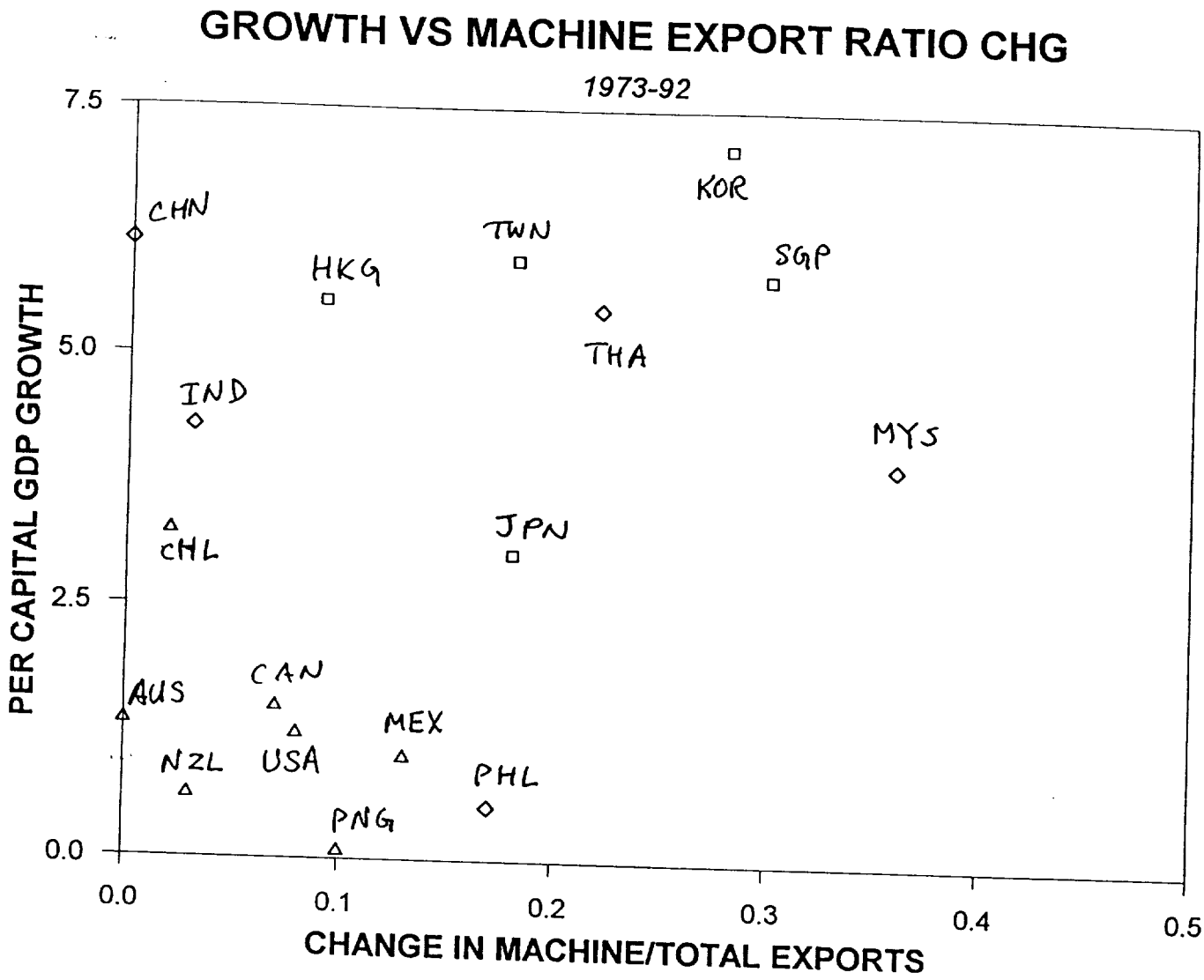

GROWTH VS MACHINE EXPORT RATIO CHG
1973-92
PER CAPITAL GDP GROWTH
CHANGE IN MACHINE/TOTAL EXPORTS
7.5
5.0
2.5
0.0
0.0
0.1
0.2
0.3
0.4
0.5
KOR
CHN
TWN
SGP
HKG
THA
IND
MYS
JPN
CHL
CAN
AUS
MEX
NZL
USA
PHL
PNG

Figure 3

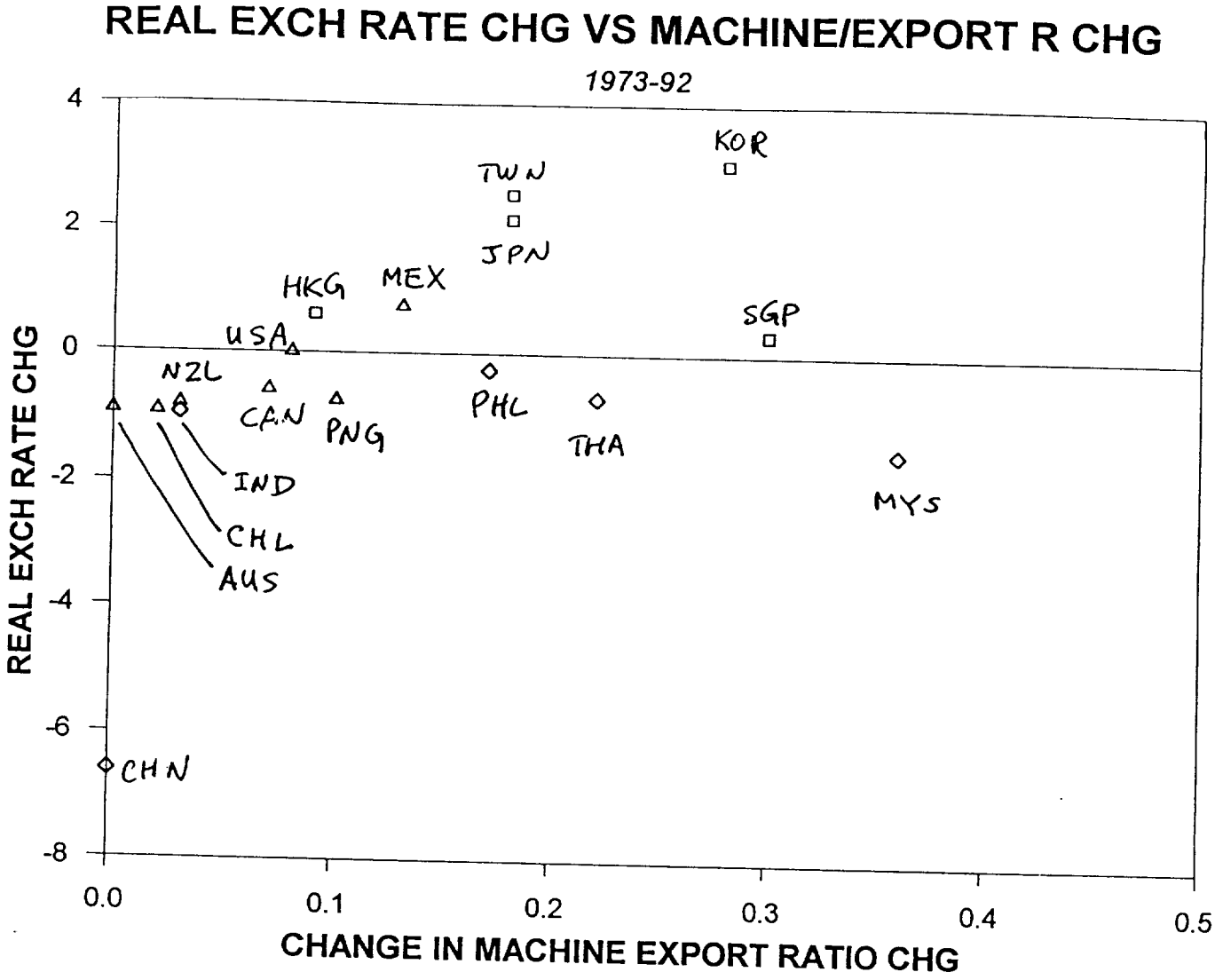
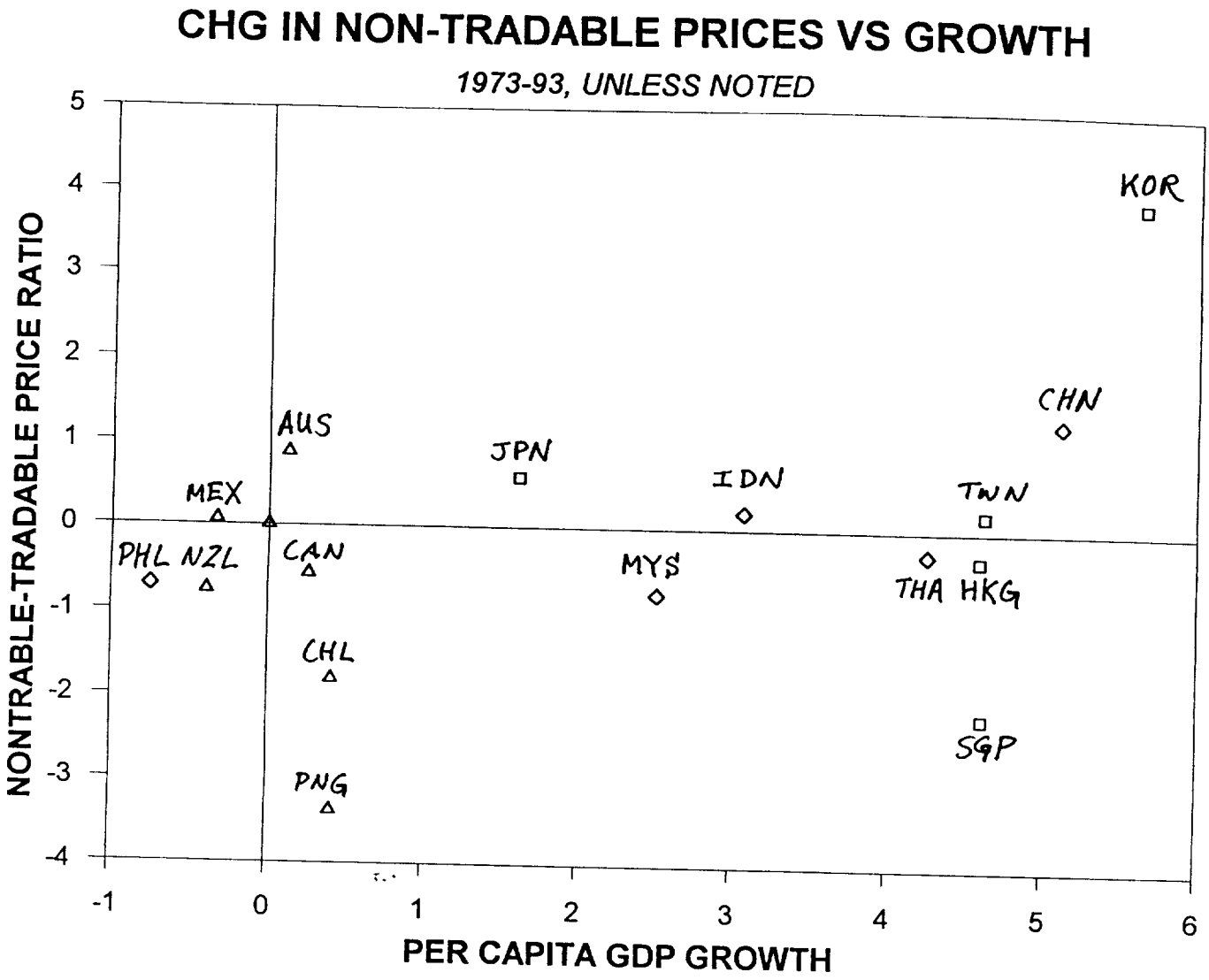

REAL EXCH RATE CHG VS MACHINE/EXPORT R CHG
1973-92
REAL EXCH RATE CHG
CHANGE IN MACHINE EXPORT RATIO CHG
4
2
0
-2
-4
-6
-8
0.0
0.1
0.2
0.3
0.4
0.5
KOR
TWN
JPN
HKG
MEX
SGP
USA
NZL
CAN
PNG
PHL
THA
MYS
IND
CHL
AUS
CHN

Figure 4



Notes: Sample periods are 1973-93. However, data restrictions limit the sample periods of the following countries as noted. Australia, 1974-93; Canada, 1973-92; Chile, 1975-88; Korea, 1973-92; Malaysia, 1974-93; New Zealand, 1977-92; PNG, 1980-93; Hong Kong, 1975-93.

Figure 5

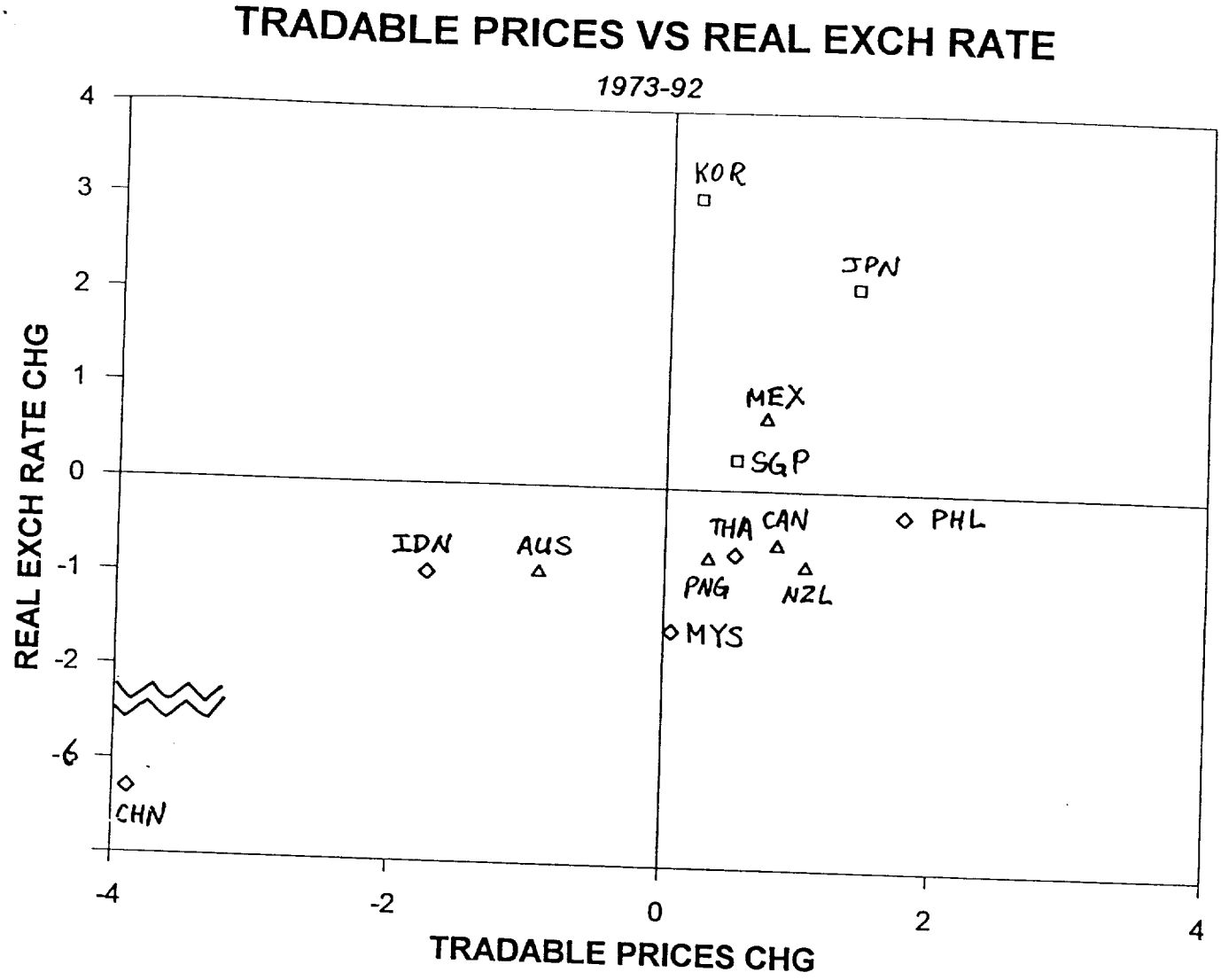

TRADABLE PRICES VS REAL EXCH RATE
1973-92
REAL EXCH RATE CHG
TRADABLE PRICES CHG
4
3
2
1
0
-1
-2
-6
-4
-2
0
2
4
KOR
JPN
MEX
SGP
IDN
AUS
THA
CAN
PHL
PNG
NZL
MYS
CHN

Figure 6 Sectoral productivity growth and inflation: Japan, 1961-92

Vertical axis, Average Sectoral inflation, %
Horizontal axis, Average Productivity growth, %

Source: OECD

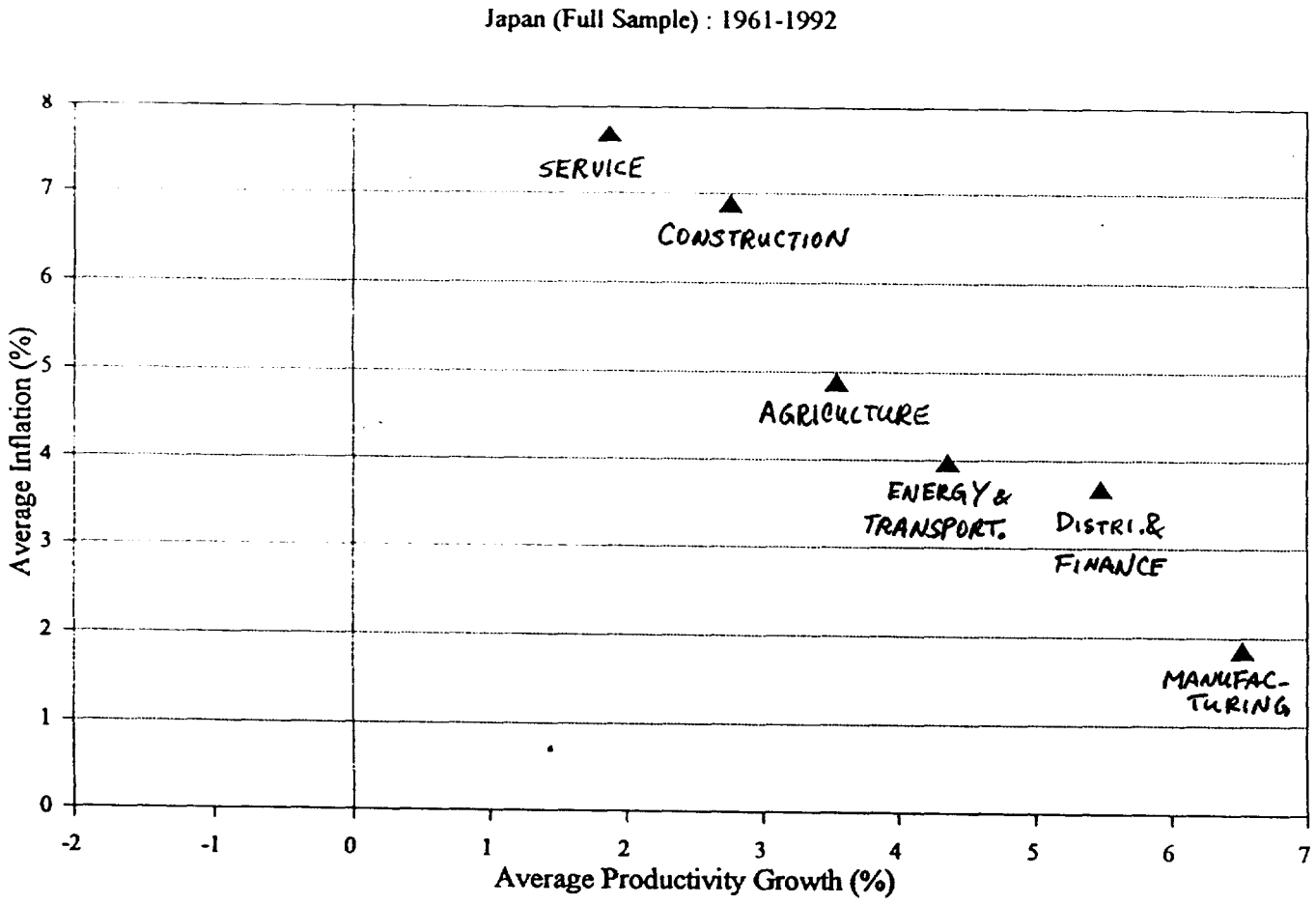


Figure 7 Sectoral productivity growth and inflation: United States, 1961-92

Vertical axis, Average Sectoral inflation, %
Horizontal axis, Average Productivity growth, %

Source: OECD