Trade Dynamics in the East Asian Miracle:

A Time Series Analysis of U.S.-East Asia Commodity Trade, 1962-1992[+]

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Abstract

We examine the composition of bilateral trade between the United States and eight Asian Pacific economies from 1962 to 1992. Two complementary time series analyses of individual commodities at the SITC four-digit level indicate that significant changes occurred in trade composition during this period. We use a measure of normalized trade balances, developed by Gagnon and Rose (1995). For the eight bilateral trade relationships, commodities representing from fifty to seventy percent of 1992 dollar trade have shown statistically significant changes in the magnitude and, in some cases, in the direction of normalized trade balances, over the thirty-year period. Results support the conclusion that changes in trade patterns in both low-tech industries, such as textiles and clothing, and more high-tech industries, such as electronic parts and electronic goods, were important in the development of the East Asian economies.

Keywords: international trade flows, time series, ADF, KPSS, trends, economic development

JEL Codes: F02, F14, F17, O14

Trade Dynamics in the East Asian Miracle

1. Introduction

Trade between the United States and the East Asian region has arguably been a contributor to the phenomenal growth of a number of the area's economies over the past several decades. Japan was the first Asian economy to take advantage of trade with the US to expand its economy and spur development. Taiwan, South Korea, Hong Kong and Singapore followed, in what has sometimes been called a "flying geese" pattern.[2] Until the financial crisis of 1997-98, Indonesia, Malaysia and Thailand were emerging as the latest Asian miracle economies, and only the first of these three struggled to recover from that crisis, while the other two have managed somewhat better.

Many empirical studies have examined the mechanisms and sources of the so-called East Asian "miracle" (e.g., Ng and Yeats, 2003; Bradford and Branson, 1987; Park and Park, 1992; World Bank, 1993). These studies suggest the importance of changing comparative advantage in the composition of US-East Asia trade. However, Gagnon and Rose (1995), in an innovative analysis of the dynamics in international trade patterns for a number of developing and advanced economies, not restricted to East Asia, found considerable persistence in the direction of net trade. Interestingly, one possible exception to this finding of persistence was South Korea, one of the East Asian tigers. Gagnon and Rose's results might be taken to imply that mechanisms such as the product cycle (e.g., Vernon, 1966), which assumes relatively rapid changes in the location of production and hence in trade patterns, have limited overall significance for economic development. Given the dynamic nature of East Asia's economies, Gagnon and Rose's analysis suggested that a closer look at changes in patterns of international trade was warranted.

[2] See Kaur (2009) for a survey and discussion of the concept and associated literature in the context of East Asian economic development.

Carolan, Singh and Talati (1998) adapted and extended the analysis of Gagnon-Rose to examine the question of dynamics in the composition of international trade flows. They focused on bilateral flows between the United States and eight East Asian economies, rather than multilateral trade for a mixed sample of countries, which Gagnon and Rose had considered. Using statistical tests and a heuristic factor-intensity-based classification (Krause, 1987) of time series of trade balances for individual commodities at the four-digit Standard International Trade Classification (SITC) level, Carolan *et al*. found strong evidence of changing trade composition between the US and the eight East Asian economies. Furthermore, this changing trade composition was consistent with changing comparative advantage and, in particular, shifts toward being net exporters of goods that were more intensive in using technology or human capital, and away from goods that were more intensive in using natural resources or unskilled labor.

In the present paper, we provide a formal time series analysis of US-East Asia trade balances, using the same data set as Carolan *et al*. While the period covered is only from 1962 to 1992, the analysis in this paper facilitates comparison with the earlier analysis of Carolan *et al.*, and permits using a data set that was already purged of errors and missing observations. It also has the virtue of focusing on the years that correspond approximately to the East Asian "miracle" as analyzed in many other studies. Unlike previous studies, however, the methodology in this paper involves a comprehensive statistical analysis of disaggregated trade patterns. Specifically, we test all four-digit SITC commodities' normalized-trade-balance[3] time series for the presence of both unit roots and trend stationarity, in order to determine whether the composition of bilateral trade has been persistent or has undergone significant change for each of the eight East

[3] This term is defined in section 3, and the construction is based on Gagnon and Rose (1995), as well as being used in Carolan et al (1998).

Asian economies considered here. For our purposes, findings of either unit root or deterministic trend stationarity can be taken as evidence for change. On the other hand, a time series that is stationary and has no deterministic trend represents a commodity whose relative importance in trade remains unchanged.

The time series analysis not only allows us to identify the most dynamic commodities but also to determine the trajectory of these commodities during the period. Furthermore, with time series methods, we obtain our results without having any preconceived assumptions about the importance of any commodity in the success of the East Asian Miracle; the data alone tells us which commodities may have played a role in East Asia's development, through their role in trade. The approach here does not require the classification according to factor intensity that was used in Carolan *et al*. (1998), nor does it focus only on changes in the sign of the trade balance. The analysis here is more general as well as more formal, and, we would suggest, it provides a useful general tool for examining the behavior of trade over sufficiently long periods of time. In that respect, the methodology introduced in this analysis has wider potential applications.

The paper is organized as follows. Section 2 provides a historical overview of the East Asian Miracle economies during the 1962 – 1992 period. Section 3 describes the data and methodology. The data is standard international trade data that has been extensively checked and validated. The econometric methodology is standard, but has not been previously applied to disaggregated trade data such as we consider here; this in itself represents an innovation of our analysis, aside from the specific results. Section 4 provides an extensive summary and discussion of the results. Our results show that there was substantial change in trade composition within our sample, and the dynamics identified fit well with expected patterns and processes of export-led

economic development. Section 5 concludes the paper, and includes some suggestions for future research.

2. Evolving Economies: A Historical Overview

GDP per capita in each of the eight countries grew significantly during the 1962 – 1992 period. As can be seen from Figure 1, Japan was far ahead of the group at the start of the period; Japan continued to maintain this lead during the period, increasing GDP per capita (in constant 2000 US$) from $8.5 thousand to $34.7 thousand. However, the East Asian Tigers (Hong Kong, South Korea, Singapore, and Taiwan) experienced the highest per-capita-GDP growth during this period and, as a result, made substantial progress in closing the per-capita-GDP gap with Japan. Indonesia, Thailand, and Malaysia lagged behind the other East Asian economies for most of this period. However, towards the end of the period, GDP per capita in these countries began to grow at rates comparable to, and even surpassing the annual growth rates of some of, the East Asian Tigers.

[Figure 1 about here]

Trade, especially exports to the United States, played a crucial role during this period. As can be seen in Table 1, between 1962 and 1992 exports to the US, both as a percent of GDP and as a percent of total exports, increased for most of the economies. Dependence on the US market increased the most for Malaysia, Taiwan and Singapore; exports to the US increased, as a percent of GDP, by 9, 10 and 21 percentage points, respectively. As a result, by 1992, these three economies were the most dependent on the U.S. market; exports to the US accounted for 15, 10,

and 23 percent of each economy's GDP, respectively. Hong Kong was the only economy where the importance of exports to the US (as a percent of GDP) decreased; yet, the drop was small (less than one percentage point) and exports to the US, nevertheless, accounted for almost 10 percent of GDP in 1992. These results show that even though nominal GDP increased at unprecedented rates during this period, exports to the US increased at an even greater rate. In other words, as Figure 2 shows, for each economy, increases in US exports (as a percent of GDP) are associated with higher GDP per capita. Hong Kong, again, is the only economy where this relationship doesn't hold.

[Figure 2 about here]

To show that the increased dependence on the US market was not simply due to an increased dependence on exports, we look at the overall importance of the US as an export destination for each of these countries. Table 1 also compares exports to the US, relative to total exports, in these countries between 1992 and 1962.[4] The US, as an export destination, increased in importance for all of the economies, except for Indonesia (-0.9 percentage points) and Japan (-0.3 percentage points). By 1992, exports to the US made up between 13 percent (Indonesia) and 29 percent (Taiwan) of total exports. Dependence on the US increased the most for Singapore and Thailand; exports to the US, as a percent of total exports, from these countries increased by 13 and 14 percentage points, respectively. By 1992, the economies most dependent on the US, using this measure, were Japan (28 percent) and Taiwan (29 percent).

[4] Indonesia, Japan, Malaysia, South Korea, and Singapore do not distinguish between re-exports and domestic exports. This is a concern as re-exports may bias the statistic. The exports to the US (as a percent of GDP) calculation does not have this problem as we use US data.

These eight East Asian economies also became important trading partners for the US. Without exception, all of the countries increased, in percentage terms, their individual share of total imports into the US.[5] Japan experienced the largest increase (almost 10 percentage points). Reflecting this growth, Japan was considerably the most important source of US imports from the region; in 1992, Japan accounted for almost 20 percent of total US imports. The second most important source from the region was Taiwan, which accounted for almost 5 percent of all US imports in 1992. Korea, Singapore and Taiwan also significantly increased their share.

Our focus in the formal statistical analysis is solely on the 1962-1992 period. Nevertheless, it is useful to consider briefly the subsequent experience of these eight economies. Three major events shaped the trajectories of these economies in the post-1992 period: the Asian Financial Crisis, the Great Recession, and the rise of China. After 1992, with the exception of Japan, the GDP per capita trend continued until the Asian Financial Crisis. Most countries were able to recover fairly quickly from the crisis, but were, again, hit by the Great Recession. The rise of China, which can be said to have begun earlier, but became truly significant in the 1990s, not only lessened the importance of the US as an export destination, but also, from the point of view of the US, decreased the importance of the eight East Asian countries as a source of US imports. These trends sharply accelerated after 1995 (Ng and Yeats, 2003, p. 19). After increasing during the 1962-1992 period, the East Asian market share of US imports declined, even when including China, during the 1992-2002 period (data not presented).[6] Only China increased its share significantly, by over 6 percentage points. It should be noted, however, that the rise of China did not necessarily come at the expense of the other Asian countries. For example, by 2007, processing exports (exports that use imported inputs) accounted for 62.5

[5] Re-exports are not a major concern in these statistics because we are using US data.
[6] For a thorough analysis on the relationship between China and the rest of Asia see Ahearne et al. (2009).

percent of China's exports to the US and the other Asian economies were a key source of the inputs used in China's global supply chain (Dean, Lovely, and Mora, 2009). Furthermore, Ahearne et al. (2009) find that China's export growth moves in "tandem" with those of the other Asian economies

[Table 1 about here]

3. Data and Basic Methodology

The data consist of comprehensive annual, bilateral trade flows disaggregated to the four-digit Standard Industrial Trade Classification (SITC) level. The years cover 1962 through 1992, with two exceptions, where the data begin in a later year.[7] Examples of goods at this level are "trucks and buses" (7322), "television receivers" (7241), "plastic polymers" (5812), and "porcelain or china household ware" (6664). Although we will use the terms "commodity" and "good," the four-digit level is commonly considered the industry level, not the individual product level. Nominal dollar values of exports and imports are available for each year and each traded commodity at this level of disaggregation.[8] However, those commodities whose time series were incomplete were ineligible for analysis; as will be seen in the results section, these commodities account for a small percent of overall trade.

[7] The exceptions are Malaysia (1964) and Singapore (1966). In general we shall ignore these two exceptions and refer to 1962 as the beginning year.

[8] As noted in Carolan, Singh and Talati (1998) the trade data do not account for re-exporting. We believe this activity to be an insignificant part of trade for all the countries with the exception of Hong Kong and, possibly, Singapore. Hong Kong serves as an entrepot for China's trade, and Singapore serves as a middleman for Malaysia and the region in general, though likely on a smaller scale than does Hong Kong. The role of Hong Kong has continued to evolve in the last decade, especially after being reintegrated with China.

Our approach to preparing the data for the time series tests follows from Gagnon and Rose (1995). For a more detailed explanation than the one presented here, see Carolan, Singh and Talati (1998). We should note, however, that some problems with the data (such as inadequate disaggregation, product quality improvements, and the dropped series) could potentially bias the results against finding any commodity dynamics: hence, findings of dynamic trade patterns should be robust. The **normalized trade balance** for commodity group *i* at time *t* is defined by

$$NB_{it} \equiv \left(\frac{X_{it}}{\sum_i X_{it}} - \frac{M_{it}}{\sum_i M_{it}} \right) * 100,$$

where X_{it} denotes the value of exports of subgroup *i* at time *t*, and M_{it} denotes imports.[9] This normalization removes the impact of macroeconomic imbalances on trade patterns, since the sum of NB_{it} for any year is always zero. For example, a macroeconomic effect, such as a 1 percent growth in exports spread uniformly across all subgroups, will not affect any individual NB_{it}. As discussed in Gagnon and Rose (1995), the data normalization also accounts for inflation, economic growth, and the increased importance of trade.

A similar normalization is used for commodity trade shares. The **normalized trade volume**, or *NV* measures the relative importance of a commodity in terms of its share of trade for a given year, as follows:

$$NV_{it} \equiv \frac{1}{2} * \left(\frac{X_{it}}{\sum_i X_{it}} + \frac{M_{it}}{\sum_i M_{it}} \right) * 100 \ .$$

[9] Since we are using US data, a positive (negative) NB implies that the US has a *normalized* trade surplus (deficit) with a particular Asian country.

NV_{it} measures the importance of trade in commodity *i* at time *t*. The sum for any time period for all commodities is 100, and thus NV_{it} conveys a percentage measure. The normalized trade volume indicates the relative importance of a particular commodity in overall trade between the US and an East Asian trade partner.

The NB variable is the focus of the time series analysis. We apply two statistical tests to the time series of the *NB* variable: the augmented Dickey-Fuller (ADF) unit root test and the Kwiatkowski, Phillips, Schmidt and Shin (KPSS, 1992) trend stationary test. We follow the methodology of Cheung and Chinn (1996) in applying the two tests.[10] Typically in time series analysis, it is critical to distinguish between a series as being either difference stationary or trend stationary. A difference stationary process is a unit root series; this means that the variance is not finite and the economic variable may wander far from its level at one point in time in an unpredictable manner (a random walk). A trend stationary series, on the other hand, does indeed wander from its level at one point in time but in a predictable pattern once the trend has been determined. For our purposes, both types of time series would imply a lack of persistence in trade composition; which is to say, both imply significant changes in the composition of commodities traded between the US and each of the eight Asian economies during the period. A unit root series for commodity trade balances would indicate that trade composition undergoes unpredictable yet significant changes in the magnitude of *NB* and, perhaps, even in the direction of trade. A non-zero trend stationary trade balance for a commodity describes a clear pattern in changing trade composition; that is an increasing (or decreasing) trade surplus (or deficit), and, possibly, also a change in the direction of trade.

[10] See also Cheung and Chinn (1997) for further discussion and analysis. We are grateful to Yin-Wong Cheung for providing us with his estimation programs, which we have used here.

In addition to allowing us to examine different forms of trade dynamics, there are also several purely statistical advantages to using both the ADF and KPSS tests. The ADF test has the unit root as the null hypothesis, but lacks power against trend stationary alternatives, potentially giving spurious unit root results. On the other hand, the KPSS test uses trend stationarity as the null hypothesis against the alternative of a unit root, so any lack of power will work in the opposite direction. Hence, as argued by Cheung and Chinn (1996, 1997), the two tests can be viewed as complementary, rather than in competition with one another.[11] Since we are interested in analyzing the dynamics in the data, and not the issue of stationarity versus non-stationarity, employing both tests is particularly appropriate. Results of all tests are reported at the 5% level of significance. For the ADF test, the finite sample critical value, from Cheung and Lai (1995), is -3.4013 at the 5% level of significance. Using either the AIC or BIC criterion for choosing the best model does not alter the results significantly; the criterion helps us to choose the number of lags and, thus, account for any serial correlation in the residual. The KPSS test finite sample critical value, from Kwiatkowski et al. (1992), is 0.14073 at the 5% level of significance. Finding trend stationarity requires identifying whether or not the trend is significantly different from zero; only the former cases indicate changing trade composition. Hence, stationarity with a *zero* trend indicates no change in trade composition for that commodity. In line with the 5% significance levels used in the ADF and KPSS tests, we use the same criteria to determine if a constant (or trend) in a model is significant; any constant with a t-statistic below 1.96 was labeled as zero-trend, as opposed to a positive or negative trend.

The unit root and trend stationary test results, as shown in Table 2, amount to eight possible categories for the normalized trade balance (*NB*) of each four-digit level commodity. In

[11] Again, see Cheung and Chinn (1996, 1997) for a more detailed discussion.

the table, "Fail to reject" refers to the inability of the ADF (KPSS) test to reject the null hypothesis of unit root (trend stationary). Rejection of the null hypothesis are marked "Reject." Additionally, for the KPSS tests that provided evidence of trend stationarity, the direction of the trend (zero, positive, or negative) is estimated. Commodities that fall under categories II-IV and VI-VII exhibited significant change in their *NB* during the period and this evidence for change was not contradicted by either of the tests. With the exception of category IV (where only evidence of a unit root is found), the categories also indicate upward or downward trends. Recall, for our data, a positive trend means either a declining normalized US trade deficit, an increasing normalized US trade surplus in a given commodity, or a shift from deficit to surplus. A negative trend means either an increasing normalized US trade deficit, a declining normalized US trade surplus in a given commodity, or a shift from surplus to deficit. The test results for categories I-III are contradictory (a series cannot exhibit both a unit root and stationarity); however, since we are interested in identifying the trade dynamics and not in classifying the commodities as either unit root or stationary, the contradiction of these tests is not critical to our results. We should also note that given that the ADF and KPSS are complementary tests of time series behavior, the failure to reject either null hypothesis in categories I-III reveals the low power of both tests. For categories I and V, one or both tests imply a zero-trend stationary series, i.e. commodities that exhibited no permanent changes in the NB during the sample period. Category VIII presents an odd or contradictory case, in which a commodity's *NB*, according to the two tests, apparently does not contain a unit root and yet is not stationary either.

[Table 2 about here]

4. Results

Table 3 shows the ADF, KPSS and trend estimation results, by country, for commodities with complete time series during the 1962-1992 period, in the form of the eight categories described above. Results appear in terms of 1992 normalized trade volume (*NV*) to indicate the relative importance of each category in overall trade at the end of the period. Each country's results are in the form of two columns, the first column is the NV value and the adjacent column is the corresponding number of four-digit SITC commodities. Notice that since the sum of *NV*s equals 100, the "Totals" row gives the share of trade, along with the number of commodities, with complete time series available for testing. The table shows that the value of trade covered ranges from 85.85% (345 commodities) for Hong Kong to 75.34% (335 commodities) for Indonesia.

While the results clearly show significant changes in the trade composition of each country, we were unable to distinguish between a unit root and a (non-zero) trend stationary process in most cases. Thus, most commodities, and the greatest share of trade, fall into categories I-III, where the tests fail to reject the null hypothesis of both unit root and trend stationarity. However, as mentioned above, this distinction is not critical for our purposes. Although category I, the category with inconsistent evidence of trade dynamics, contains the greatest number of commodities for all countries, except Japan, it does not have a correspondingly high share of NV. The categories (IV-VII) that clearly distinguish between the two types of data generating processes account for a relatively small percent of trade for all countries. Fortunately, a relatively small share of trade falls into category VIII, the odd case, with minor exceptions for Japan (15 percent) and Taiwan (13 percent).

Category III contains the single greatest share of NV for six of the eight economies: Hong Kong, Japan, Korea, Singapore, Taiwan and Thailand. This means that the most important dynamic commodities, in terms of NV, have a negative trend and, thus, are increasing, or moving towards, a normalized US trade deficit. The key role of commodities with a negative trend is reinforced when comparing the commodities that fall in categories with positive trend (II and VI) and negative trend (III and VII); all economies, except Malaysia, show greater NV with a negative trend than with a positive trend. This outcome is indicative of the successes of the export-led growth model of the region.

[Table 3 about here]

For the remainder of the paper we will focus on the categories where changes in trade composition are significant and not contradicted by either the ADF or KPSS tests; that is, categories II, III, IV, VI and VII. Again, it should be reiterated, these categories do not necessarily indicate a change in the direction of net trade, that is, either a change from a net surplus to a net deficit or vice versa. The trend merely tells us the general direction of change of NB, the normalized trade balance, e.g., moving from a smaller to a bigger surplus. Indonesia has the smallest percent of "dynamic trade" according to our analysis, at 49.37 *NV*, but still nearly half of its normalized trade volume, while Hong Kong has the largest percent at 70.75 *NV*. SITC sectors 7 (Machinery) and 8 (Manufactured articles) contain most of the *NV* for the "dynamic" *NB* commodities. This finding is critical, as these sectors are widely discussed as important driving forces behind the East Asian miracle. For a more disaggregated analysis see later in this section.

For illustrative purposes, time series graphs for five commodities, one for each category of interest, are presented in Figure 3. We used data for Japan and purposely choose five commodities that undergo a reversal in the normalized direction of trade, to highlight the most dramatic possible changes. For Japan, the most common category was III (accounting for 24 % of NV), followed by category II (accounting for 16% of NV). As can be seen in the figures, the detailed time patterns vary significantly, for some commodities the changes are gradual, but for others they are abrupt in certain years. This may reflect industry specific factors, but providing a detailed discussion of any specific industry is beyond the scope of this paper.

[Figure 3 about here]

[Table 4 about here]

As already noted, most of the changes in trade composition took place in SITC sector 7 (Machinery) and sector 8 (Manufactured articles). Sector 7 is comprised of machinery, electronic equipment, and transportation vehicles; and sector 8 includes mostly consumer manufactures. Table 4 aggregates the 1992 *NV* according to one-digit level SITC sector for only those *NB* commodities that fall into the categories of interest. The sector dominating the trade dynamics in most of the Asian economies, as measured by the dollar trade share, is sector 7. The only exceptions are for Hong Kong and Indonesia, where sector 8 dominates the others. Since sector 7 tends to have more technologically advanced products, the high share of sector 7 products means that highly sophisticated products (both final and intermediate goods) explain most of the trade dynamics for these Asian countries. Furthermore, we find that Hong Kong and Indonesia are

different. It is clear that Indonesia is the country whose trade growth is most reliant on less sophisticated products. Interpreting Hong Kong's high share of sector 8 products is complicated by the fact that Hong Kong acts as an official (and unofficial) re-exporter for goods produced in many Asian countries, especially China (Ferrantino and Wang 2007); thus, some of the dynamics in these sectors may be exaggerated, or distorted in other ways. Other sectors with large NV shares include: sector 2 (raw materials from agriculture, forestry, and the textile and metal industries) for Indonesia and sector 0 (raw and processed foods, excluding beverages) for Japan. In general, and also in terms of *NV*, little change occurs for sectors 0-6, and sector 9.

[Table 5 about here]

Given the significant changes in trade composition identified above, it is important to look at the specific commodities driving this transformation. Disaggregating the results by commodity allows us to identify key differences among the Asian countries; these differences were mostly concealed at the sector level. Table 5 lists the top ten dynamic commodities for each country, in terms of trade volume (1992 NV). Looking at the top dynamic products we can clearly identify the "flying geese" pattern: Japan leads the group with the most technologically-advanced trade basket; the East Asian Tigers have a mixed trade basket; and the rest of the East Asian economies in our sample rely mainly on intermediate goods and relatively low-tech products.

Japan has the most technologically-sophisticated product composition; Japan's top ten products almost all fall in sector 7 (Machinery) and only two commodities have a positive trend. Again, a positive trend in this case means either the US is increasing its normalized trade surplus

with Japan, the US is decreasing its normalized trade deficit, or a shift from deficit to surplus. Japan is the only economy that does not have any textile or clothing commodities in its top ten commodities. These results are generally consistent with the view of Japan as the leader of the East Asian economies, particularly in trade with the world's advanced economies. It is also consistent with the view of Japan as head goose, whose dominance was a result of its ability to "invent and innovate" and eventually progress towards more capital intensive goods (for a more detailed explanation, see Kaur, 2009).

The East Asian Tigers also significantly shifted their trade composition with a movement towards industrial upgrading during the period. The Tigers have a mix of high and low technology products; the low-tech products tend to vary significantly from country to country, but the high-tech products tend to be shared by these countries. The most important low-tech product for each country in the sample period is as follows: "textiles" (negative trend) for Hong Kong, "footwear" (negative trend) for Korea, "textiles" (positive trend) for Singapore, and "furniture" (negative trend) for Taiwan. Several products are shared with Japan: all have "telecommunications equipment, nes" (negative trend) as a top ten commodity; Hong Kong, Singapore, and Taiwan share "transistors, valves, etc" (unit root for Japan, but positive trend for the Tigers); and Hong Kong, Singapore, and Korea share "statistical machines" (positive trend for Hong Kong, unit root for Korea, and a negative trend for the rest, including Japan). Other shared commodities include: "aircraft parts, etc" (positive trend) and "office machines, nes" (negative trend) for Singapore and Korea and "passenger motor vehicles, excluding buses" Korea (negative trend) and Taiwan (positive trend).

The top ten commodities for Indonesia, Malaysia, and Thailand tend to be, with few exceptions, dominated by low-tech, labor-intensive, and intermediate products. The only low-

tech commodities these countries have in common are "clothing, accessories knit" and "textile clothes, not knit"; in both cases, the time series have negative trends for Malaysia and Thailand, but unit root for Indonesia. There are some common higher-tech products: "telecommunications equipment, nes" for Indonesia (positive trend) and Malaysia (negative trend); "transistors, valves, etc" (positive trend) and "phonographs, tape & other sound recorders, etc." (negative trend) for Malaysia and Thailand; and "Aircraft parts, etc" (negative trend) for Indonesia and Thailand.

Most commodities that appear in the top ten groups across countries have a similar trend. This may either be evidence that the countries are in direct competition with one another or that they are producing similar, complementary products, but for different parts of the value chain.[12] For example, "transistor, valves, etc", which may include inputs into various parts of the value chain, is a top ten product for all countries, except Indonesia and Korea, and, in each case, the trend is non-negative. Note, however, that Japan is the only economy for which "transistors, valves, etc" end the period with a negative *NB* (not shown in the tables). Another common commodity is "textile clothes, not knit", appearing in every country, except Japan and Korea. "Textile clothes, not knit" offer an interesting example because they do not have a common trend among the economies and yet the NB for every economy was negative by the end of the period. Textiles have negative trends in Hong Kong, Malaysia, and Thailand; Textiles have unit root with no trend for Indonesia; and they have a positive trend for Singapore and Taiwan.[13] This can be seen as evidence of the more developed countries moving away from dependence on textiles

[12] To determine whether the countries a providing competing or complementary products we would need a higher level of disaggregation (something that is beyond the scope of this paper).
[13] We should note that Hong Kong's large share (12.24 *NV*) of "textile clothes not knit" may reflect Hong Kong's role as a re-exporter for China.

and into more technologically advanced products; and also of the increased importance of textiles for developing countries.

Finally, looking at the top ten products, we continue to see the dominance of commodities with negative trends. In other words, most of the dynamics come from commodities where the normalized US trade surplus decreased or the normalized US trade deficit increased. Only Singapore has more commodities with a positive trend than a negative trend. However, its top commodity ("statistical machines") has a negative trend and accounts for 21 % of NV. For all countries, the accumulated share of NV is much larger for commodities with a negative trend than those with a positive trend.

Trade with the US, as we saw in section 2, played a critical role in the success of these Asian countries. In this paper, we have been able to objectively identify the most dynamic sectors during the period. To summarize the results of the various tables, measured by 1992 *NV*, a large portion of trade has undergone change for all eight economies. Most changing *NB* occurs in sectors 7 and 8. Some of the more important commodities in these two sectors that are common across several of the economies include "textile clothes, not knit" (8411), "clothing, accessories knit" (8414), "footwear" (8510), "transistors, valves, etc" (7293), "statistical machines" (7143), and "telecomm equipment, nes" (7249). It is perhaps no surprise to state that textiles, clothing or shoes and electronic intermediate and final goods play important roles in the changing composition of trade between the US and East Asia. But we provide new evidence in support of this statement. In general for these eight Asian economies, textiles, clothing and shoes represent the low-tech element in trade and electronic goods represent a more high-tech element in trade. For Japan, we find evidence in trade data supporting its role as the economic leader of the East Asian economies during the period analyzed.

5. Concluding Remarks

This paper has examined the dynamic composition of US-East Asian trade for the period extending from 1962 to 1992. The innovation of this paper is in applying formal statistical tests for the existence of trend stationarity and unit root processes to detailed time series of disaggregated bilateral international trade flows. The question motivating the analysis has been a simple one: has trade between the United States and eight Asian economies been persistent in composition or has it shown significant change? Unlike previous studies (Gagnon and Rose, 1995; Carolan *et al*., 1998), we have not restricted change in trade composition to reversals in direction of trade; that is, commodities that experience a change from having a normalized trade surplus to a normalized trade deficit, and vice versa. To answer the question, we have applied ADF and KPSS tests to four-digit SITC trade data between the US and eight East Asian economies, or over 2000 time series. Although both time series tests exhibit low power, the results clearly show changing trade patterns for these eight US trade partners. Evidence presented here supports the previous results of Carolan *et al*., which found significant changes in the composition of trade between the United States and East Asia.

One important contribution of our paper is methodological. We have applied time series tests that have previously been applied to macroeconomic data to make a detailed and extensive analysis of over 2,000 time series of normalized international trade balances. In doing so, we have indicated an approach that can be useful in other contexts, to examine the kind of questions posed by Gagnon and Rose, in using disaggregated trade data to empirically test implications of product cycle or other theories of dynamic trade patterns. Until recently, such tests were not possible, because time series of trade data were not long enough, and statistical tests of time

series properties relied on critical values from asymptotic theory. Both the empirical and theoretical constraints have been relaxed, and we suggest our approach can assist in the understanding of changes in trade patterns over time.

We find that the countries exhibited not only large trade growth during the 1962-1992 period, but that the trade growth was led by "dynamic" categories of products, goods with non-stationary normalized trade balances. For the East Asian economies, between 49 and 71 percent of the 1992 normalized trade value with the US was in these dynamic trade categories. Sector 7 and sector 8 were the driving sectors, but the specific products vary significantly from country to country. We find that most of the dynamics come from technologically advanced products, with a clear flying geese pattern: Japan had the most technologically advanced, dynamic trade basket; the East Asian Tigers followed with a mixed trade basket; and the rest of the East Asian sample still depended, in the sample period, on less advanced products, though it was starting to specialize in a few technologically advanced goods (possibly intermediate goods). To conclude, our results show clear evidence of changing trade patterns, which is also more in line with the product cycle theory. These results contrast sharply with those of Gagnon and Rose (1995), who find considerable persistence in the direction of net trade and, thus, evidence against the product cycle theory.

Further research should focus on several areas. First, how do the results change with more complicated models: for example, what role do exchange rates play? ; does controlling for other variables change the results? Second, expanding the data series forward to include the rise of China and the period of the Asian Financial Crisis would allow us to see if any trade dynamics

are lost (or gained) as a result of these two events.[14] The post-1992 period changed many of the patterns seen during the Asian Miracle period covered in this paper. Lastly, what role, if any, did increased trade fragmentation play in accelerating the trade dynamics? Does trade fragmentation help to explain a possible breakup of the flying geese pattern? Research on Asian trade dynamics would benefit greatly by accounting for these last two points, as the international landscape changed significantly with the rise of China and the increasing importance of trade fragmentation (e.g., Kaur, 2009 and Athukorala and Yamashita, 2006). A new pattern of trade dynamics appears to be emerging, perhaps characterized by both more competition and more opportunities.

[14] There is, of course, already a large body of work on China and its trade patterns (e.g., Fernald et al., 1999; Carter and Li, 2002; Lum and Nanto, 2007; IMF, 2011), but not with precisely the approach used in the current analysis.

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Table 1: Country Exports to the US (1962 vs 1992)

	Exports to the US (share of GDP)			Exports to the US (share of total exports)			Exports to the US (share of US Imports)		
Country	**1962[a]**	**1992**	**Change**	**1962[b]**	**1992**	**Change**	**1962**	**1992**	**Change**
HKG	10.7	9.9	**-0.9**	23.2	27.6	4.4	1.0	1.9	0.8
IDN	3.4	3.5	0.1	14.0	13.1	**-0.9**	0.8	0.9	0.1
JPN	2.2	2.6	0.4	28.7	28.4	**-0.3**	8.3	18.2	9.8
KOR	0.4	5.5	5.1	23.5	23.8	0.3	0.1	3.1	3.1
MYS	6.0	14.5	8.6	12.6	18.6	6.0	0.0	1.6	1.6
SGP	1.8	23.2	21.4	8.4	21.1	12.8	0.1	2.1	2.0
THA	1.3	7.1	5.8	8.8	22.5	13.6	0.2	1.4	1.2
TWN	0.5	10.2	9.7	25.4	29.0	3.6	0.4	4.7	4.3

Source: IMF & UN COMTRADE

a) Data from Indonesia is only available after 1967 & data from Malaysia is only available after 1964.

b) Trade data reported by Malaysia is only available after 1965.

Table 2: ADF, KPSS and KPSS Trend Estimation Categories

Category	ADF H_0: Unit Root	KPSS H_0: Trend Stationarity	Trend Estimation
I	Fail to reject	Fail to reject	Zero
II	Fail to reject	Fail to reject	Positive
III	Fail to reject	Fail to reject	Negative
IV	Fail to reject	Reject	Not applicable
V	Reject	Fail to reject	Zero
VI	Reject	Fail to reject	Positive
VII	Reject	Fail to reject	Negative
VIII	Reject	Reject	Not applicable

Table 3: ADF, KPSS and KPSS Trend Estimation Results

	Hong Kong		Indonesia		Japan		Korea	
Category	**1992 NV**	**Count**	**1992 NV**	**Count**	**1992 NV**	**Count**	**1992 NV**	**Count**
I	9.73	117	17.91	152	7.86	57	25.52	119
II	22.36	89	16.72	49	16.22	118	12.71	75
III	38.16	81	13.17	69	24.44	81	26.19	80
IV	2.83	19	10.15	17	10.37	59	7.86	28
V	2.02	8	2.24	15	0.10	3	3.53	15
VI	5.61	11	0.30	3	2.57	10	1.55	11
VII	1.79	4	9.02	18	7.39	4	3.20	7
VIII	3.35	16	5.83	12	15.36	13	2.08	9
Totals	85.85	345	75.34	335	84.31	345	82.65	344

	Malaysia		Singapore		Taiwan		Thailand	
Category	**1992 NV**	**Count**	**1992 NV**	**Count**	**1992 NV**	**Count**	**1992 NV**	**Count**
I	11.49	135	13.77	162	11.66	111	15.67	114
II	33.72	35	26.26	61	16.28	86	13.65	46
III	23.09	113	33.87	83	24.59	79	27.05	113
IV	0.97	16	0.01	1	6.00	31	3.02	16
V	1.66	11	0.99	8	0.34	9	0.93	12
VI	1.29	7	0.31	9	5.90	6	1.18	8
VII	10.19	13	8.77	12	3.85	6	9.43	13
VIII	0.30	6	1.27	4	12.69	17	4.46	13
Totals	82.71	336	85.26	340	81.32	345	75.39	335

Table 4: *NB* Change Commodities (Categories II, III, IV, VI, VII) 1992 *NV*,

Grouped by SITC Sector		Hong Kong		Indonesia		Japan		Korea	
SITC Sector	**SITC Name**	**NV**	**Cum. NV**	**NV**	**Cum. NV**	**NV**	**Cum. NV**	**NV**	**Cum. NV**
0	Food & animals	2.51	2.51	3.69	3.69	8.72	8.72	2.76	2.76
1	Bev. & tobacco	2.39	4.9	0	3.7	0.69	9.41	0.44	3.19
2	Crude materials	2.15	7.05	9.18	12.87	2.74	12.14	4.9	8.09
3	Mineral fuels	0.09	7.14	0.72	13.59	0.48	12.63	0.7	8.79
4	Animal & veg. oils	0	7.14	0.36	13.96	0.02	12.65	0.06	8.85
5	Chemicals	1.22	8.36	0.73	14.68	1.45	14.11	0.91	9.75
6	Manufact goods	4.74	13.1	6.67	21.36	3.28	17.39	4.22	13.97
7	Machinery	20.27	33.37	7.94	29.3	32.82	50.21	21.29	35.26
8	Manufact articles	33.84	67.22	20.07	49.37	8.71	58.91	14.3	49.57
9	Others	3.54	70.75	0	49.37	2.08	61	1.94	51.51

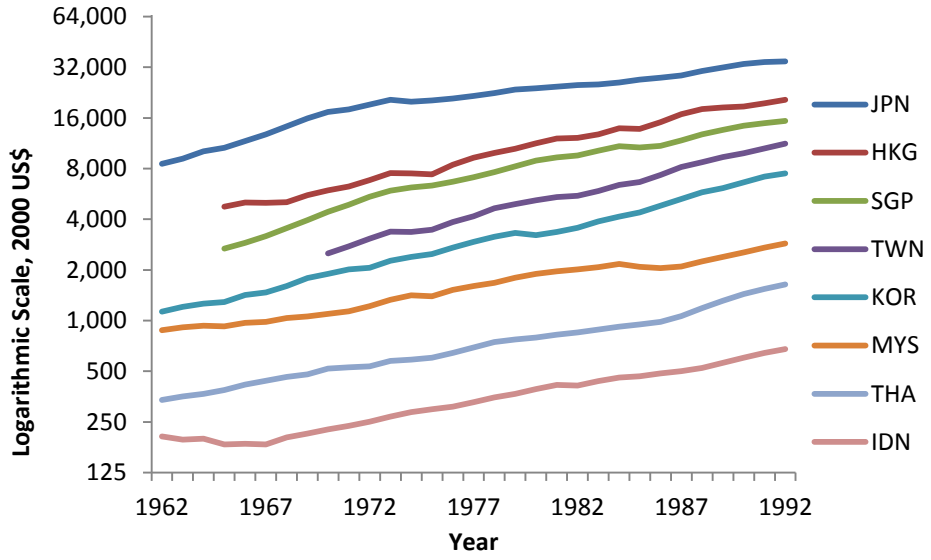
		Malaysia		Singapore		Taiwan		Thailand	
SITC Sector	**SITC Name**	**NV**	**Cum. NV**	**NV**	**Cum. NV**	**NV**	**Cum. NV**	**NV**	**Cum. NV**
0	Food & animals	1.24	1.24	0.72	0.72	3.84	3.84	5.11	5.11
1	Bev. & tobacco	0.49	1.72	0.13	0.85	0.46	4.3	1.08	6.19
2	Crude materials	1.67	3.39	0.28	1.12	1.79	6.09	2.88	9.07
3	Mineral fuels	0.1	3.5	0.01	1.13	0.6	6.69	0.51	9.58
4	Animal & veg. oils	0.03	3.53	0.01	1.14	0.01	6.7	0	9.58
5	Chemicals	0.65	4.18	0.64	1.78	0.48	7.18	0.96	10.54
6	Manufact goods	2.21	6.39	1.52	3.3	4.58	11.76	2.89	13.43
7	Machinery	49.01	55.4	54.95	58.24	29.39	41.15	22.87	36.3
8	Manufact articles	12.02	67.42	7.63	65.87	12.88	54.04	15.87	52.17
9	Others	1.83	69.25	3.35	69.22	2.59	56.63	2.16	54.33

Table 5: Top Ten Change Commodities, by 1992 *NV*

Economy and Commodity	1992NV	CATEGORY				
		II	III	IV	VI	VII
Hong Kong						
8411 TEXTILE CLOTHES NOT KNIT	12.24		X			
8414 CLOTHING,ACCESSORYS KNIT	9.69		X			
7293 TRANSISTORS,VALVES,ETC	6.48	X				
7143 STATISTICAL MACHINES	3.66				X	
9310 SPECIAL TRANSACTIONS	3.53	X				
7249 TELECOMM EQUIPMENT NES	2.52		X			
8641 WATCHES,MOVEMENTS,CASES	2.36		X			
1222 CIGARETTES	1.97	X				
8971 REAL JEWELRY,GOLD,SILVER	1.56		X			
8930 ARTICLES OF PLASTIC NES	1.17				X	
Indonesia						
8510 FOOTWEAR	7.13		X			
8411 TEXTILE CLOTHES NOT KNIT	6.22			X		
2311 NATURAL RUBBER,GUMS	5.32	X				
6312 PLYWOOD	4.12					X
7249 TELECOMM EQUIPMENT NES	2.73	X				
8414 CLOTHING,ACCESSORYS KNIT	2.59			X		
7349 AIRCRAFT PARTS,ETC	1.87	X				
2517 SULPHATE WOOD PULP	1.46	X				
0313 SHELL FISH FRESH,FROZEN	1.27		X			
8210 FURNITURE	1.20		X			
Japan						
7143 STATISTICAL MACHINES	6.40					X
7293 TRANSISTORS,VALVES,ETC	3.60			X		
7328 MOTOR VEHICLE PARTS NES	3.46		X			
7249 TELECOMM EQUIPMENT NES	3.30		X			
7149 OFFICE MACHINES NES	3.07		X			
9310 SPECIAL TRANSACTIONS	1.76				X	
0311 FISH FRESH,CHILLED,FROZN	1.75	X				
7115 PISTON ENGINES NON-AIR	1.67		X			
0440 MAIZE UNMILLED	1.62			X		
8616 PHOTOGRAPHIC EQUIP NES	1.41		X			
Korea						
8510 FOOTWEAR	4.50		X			
7143 STATISTICAL MACHINES	3.91			X		
7249 TELECOMM EQUIPMENT NES	2.92		X			
7321 PASS MOTOR VEH EXC BUSES	2.39		X			
8413 LEATHER CLOTHES,ACCESRYS	2.12		X			
8911 SND RECRDRS,PHONOGR,PRTS	2.11		X			
2111 BOVINE,EQUINE HIDES	1.90	X				
7242 RADIO BROADCAST RECEIVRS	1.43		X			
9310 SPECIAL TRANSACTIONS	1.37	X				

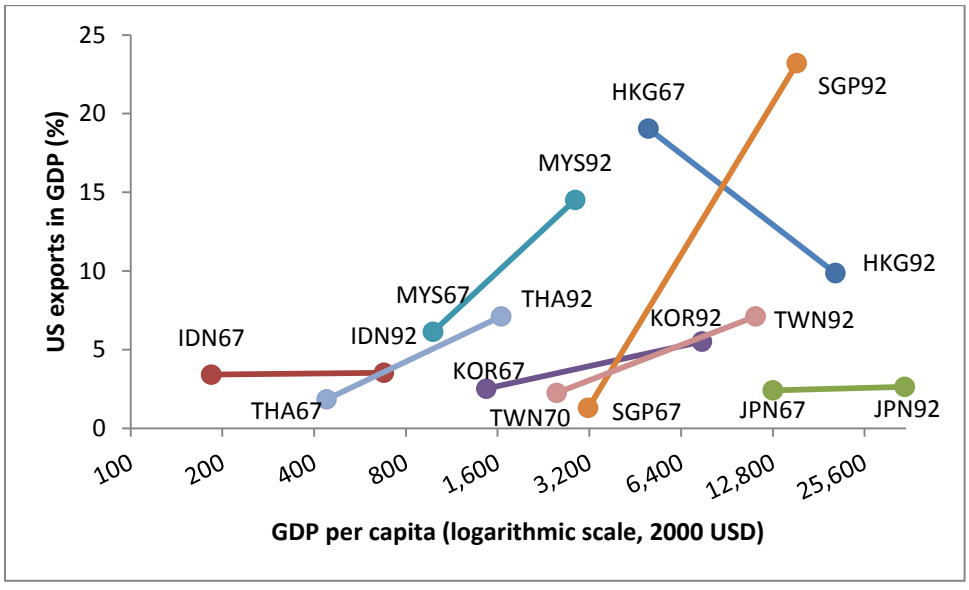
7349 AIRCRAFT PARTS,ETC	1.30	X					
Malaysia							
7293 TRANSISTORS,VALVES,ETC	30.51	X					
7249 TELECOMM EQUIPMENT NES	5.19		X				
7242 RADIO BROADCAST RECEIVRS	5.16						X
8911 SND RECRDRS,PHONOGR,PRTS	4.09						X
8411 TEXTILE CLOTHES NOT KNIT	2.36		X				
9310 SPECIAL TRANSACTIONS	1.76		X				
8414 CLOTHING,ACCESSORYS KNIT	1.33		X				
8942 TOYS,INDOOR GAMES	1.27		X				
7241 TELEVISION RECEIVERS	1.18		X				
7299 OTH ELECTRICAL MACHINERY	1.16		X				
Singapore							
7143 STATISTICAL MACHINES	21.49		X				
7293 TRANSISTORS,VALVES,ETC	13.14	X					
7149 OFFICE MACHINES NES	6.96						X
8912 SOUND RECRDNG TAPE,DISCS	3.40	X					
9310 SPECIAL TRANSACTIONS	3.28	X					
7249 TELECOMM EQUIPMENT NES	3.25		X				
7349 AIRCRAFT PARTS,ETC	1.92	X					
8411 TEXTILE CLOTHES NOT KNIT	1.20	X					
7192 PUMPS,CENTRIFUGES	1.07		X				
7114 AIRCRAFT ENGINES INC JET	0.86	X					
Taiwan							
7293 TRANSISTORS,VALVES,ETC	6.01	X					
7321 PASS MOTOR VEH EXC BUSES	4.99				X		
7149 OFFICE MACHINES NES	3.45						X
7249 TELECOMM EQUIPMENT NES	3.22		X				
8210 FURNITURE	2.67		X				
8942 TOYS,INDOOR GAMES	2.36		X				
8411 TEXTILE CLOTHES NOT KNIT	2.28	X					
0440 MAIZE UNMILLED	2.09	X					
9310 SPECIAL TRANSACTIONS	1.81			X			
7250 DOMESTIC ELECTRIC EQUIP	1.27		X				
Thailand							
7293 TRANSISTORS,VALVES,ETC	6.93	X					
7143 STATISTICAL MACHINES	5.41		X				
0320 FISH ETC TINNED,PREPARED	2.69		X				
8971 REAL JEWELRY,GOLD,SILVER	2.44						X
8414 CLOTHING,ACCESSORYS KNIT	2.44		X				
8411 TEXTILE CLOTHES NOT KNIT	2.31		X				
8911 SND RECRDRS,PHONOGR,PRTS	2.14						X
7349 AIRCRAFT PARTS,ETC	1.81	X					
9310 SPECIAL TRANSACTIONS	1.62	X					
7241 TELEVISION RECEIVERS	1.55						X

Figure 1: GDP per capita (constant 2000US$)



Source: IMF, World Bank, & EconData

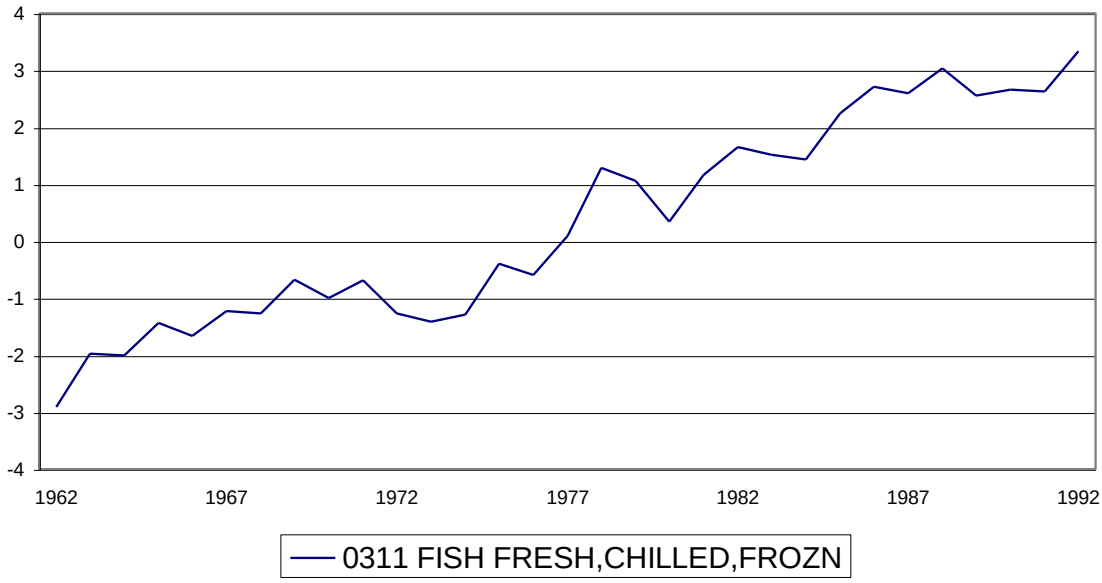
Figure 2: Exports to the US in GDP and GDP per capita



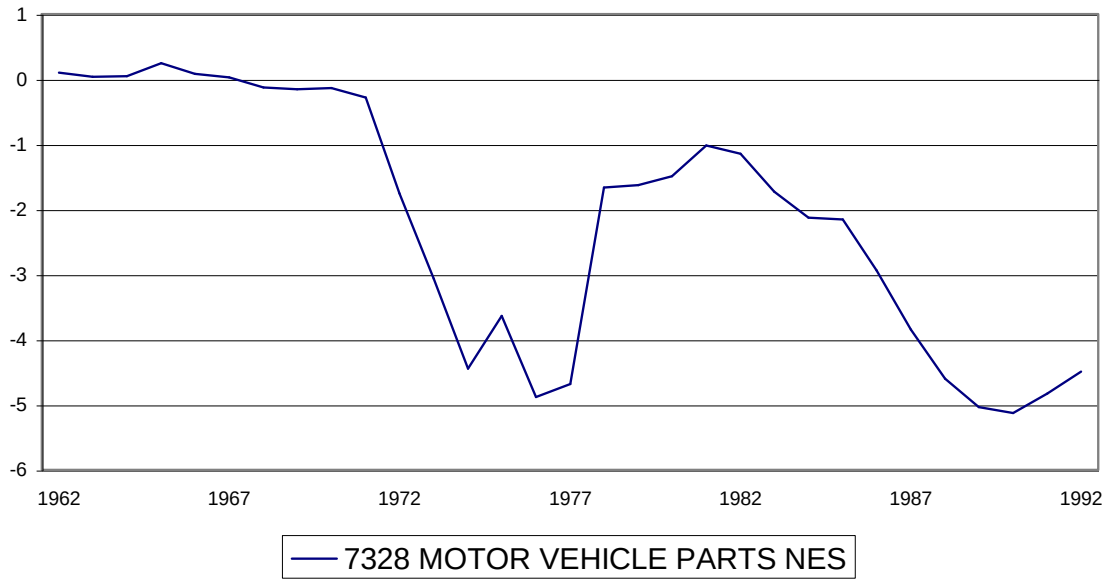
Source: IMF, UN COMTRADE, & EconData

Figure 3: *NB* Time Series Graphs for Japan
(Only categories of interest are presented)

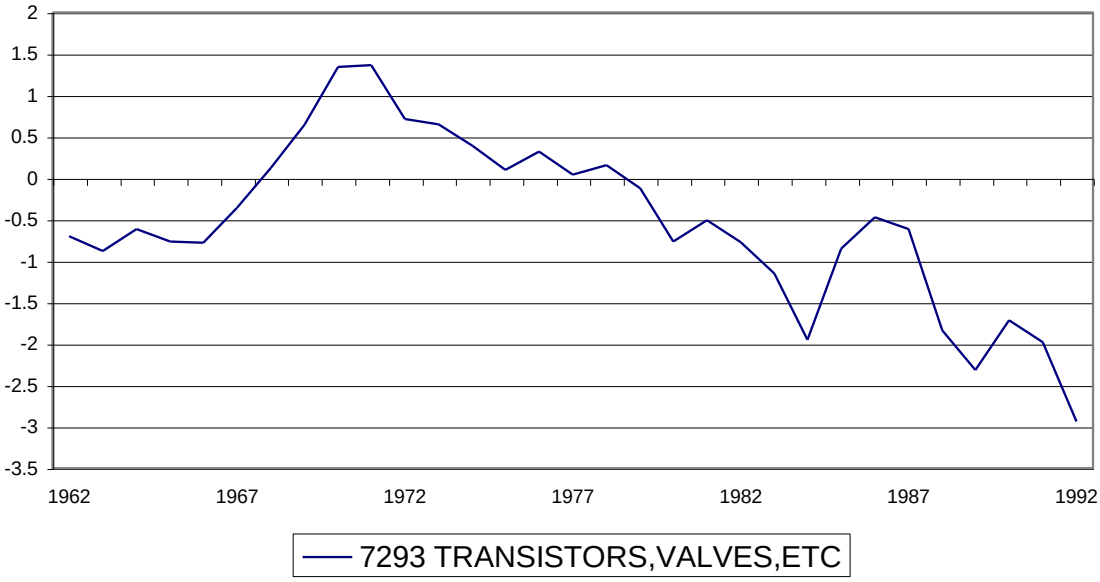
Category II: ADF Fail, KPSS Fail and Positive Trend



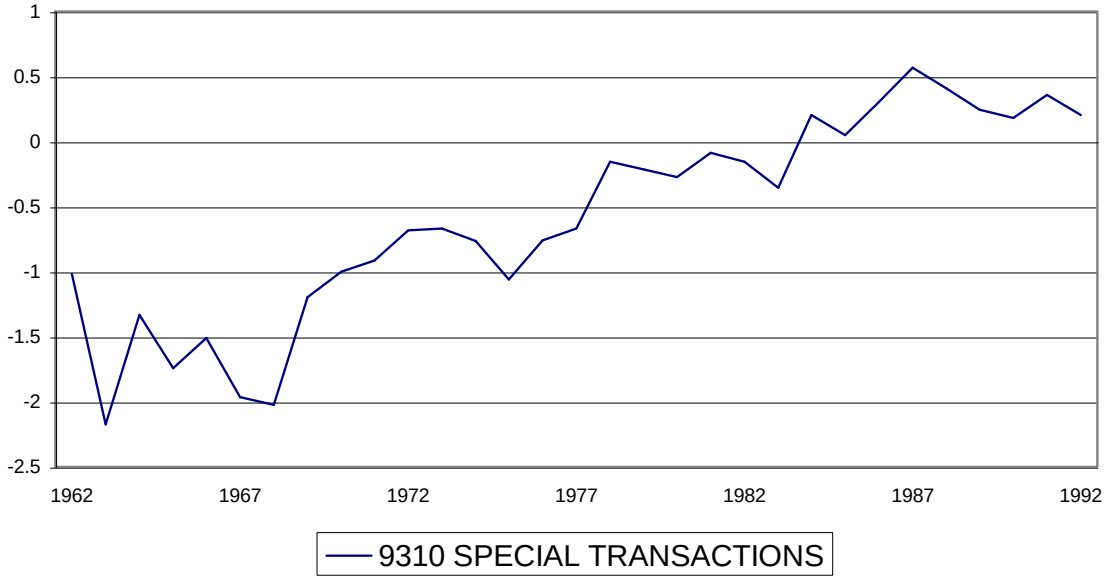
Category III: ADF Fail, KPSS Fail and Negative Trend

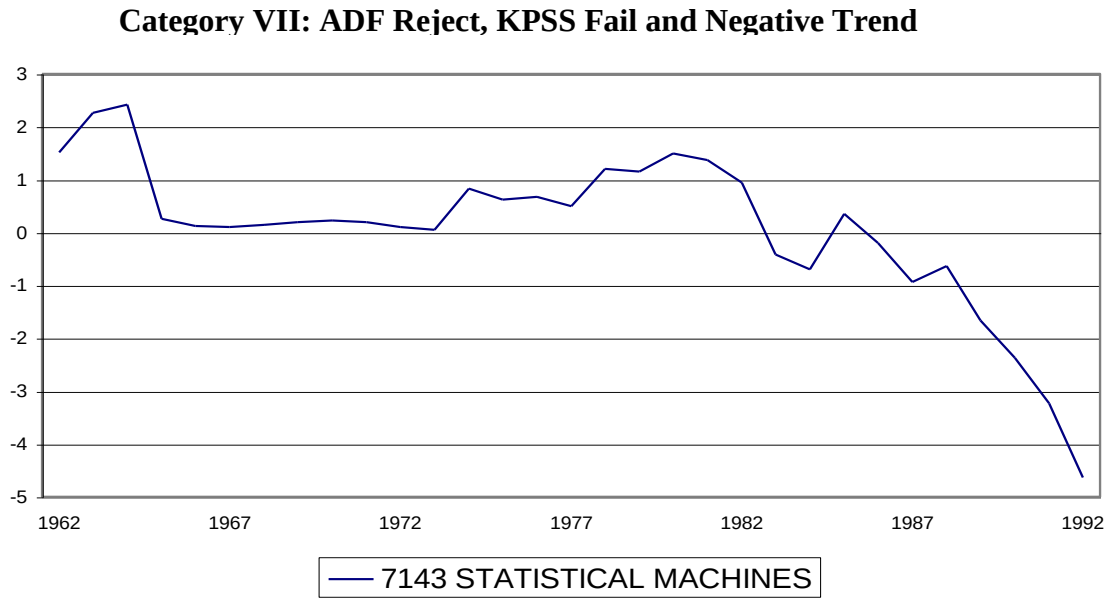


Category IV: ADF Fail and KPSS Reject



Category VI: ADF Reject, KPSS Fail and Positive Trend




Category VII: ADF Reject, KPSS Fail and Negative Trend
3
2
1
0
-1
-2
-3
-4
-5
1962
1967
1972
1977
1982
1987
1992
7143 STATISTICAL MACHINES