Exporting Deflation?

Chinese Exports and Japanese Prices

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The spectacular growth of China in the last two decades has caused China to replace Japan as the major new source of US imports and destination for our exports. This perception has not gone unnoticed by Japanese who often bemoan the relative decline of the perceived importance of Japan with the phrase, "Japan Passing". Much less well known in the US is how the rapid growth of trade with China is affecting the world's second largest economy. The explosion of trade between Japan and China has had profound impacts on the Japanese economy and is frequently seen as a source of Japan's persistent deflation. For example, in a now famous article in the *Financial Times* the Vice Minister and Deputy Vice Minister for International Affairs at the Japanese Ministry of Finance wrote,

> "The entry of emerging market economies - such as China and other east Asian nations - into the global trading system is a powerful additional deflationary force. Their combined supply capacity has been exerting downward pressure on the prices of goods in industrialised economies…. China is exporting deflation and its effects are not limited to neighboring Hong Kong and Taiwan."[1]

The notion that China was exporting deflation by exporting goods at low prices was repeated by market analysts and policymakers both inside and outside of Japan.

In this paper, we assess the impact that Chinese exports have had on Japanese prices in the years between 1992 and 2004. We start by showing that while the official Japanese import price index has fallen over this period, an import price index computed using the same methodology as the consumer price index would have resulted in substantial *inflation* over this period. This suggests that while the export of individual countries might have exerted deflationary pressures on Japanese prices, at the aggregate level (when measured using the same methods) this pressure fades away as import prices have risen faster than consumer prices. The

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[1] Kawai, Masahiro and Haruhiko Kuroda, "Time for a switch to global reflation," *Financial Times*, London, December 2, 2002, p. 23.

fact that index number problems are sufficiently large in Japanese import price data to mix up deflation with inflation could easily have confused policymakers and economists alike about how trade was affecting price movements in Japan.

Despite this aggregate pattern, the notion that China might be exporting deflation may be warranted given the importance of China in Japan's trade and the perception that Chinese products are falling in price. The rise in importance of China in Japan's import and export structure over this period has been dramatic and has happened simultaneously with a sharp decline in the importance of the US. In 1992 the US exported three times as much to Japan as China; by 2005, China was exporting twice as much as the US. Moreover, between 1992 and 2005, the number of new imported varieties entering Japan rose by 32 percent and China played an enormous role in this expansion – accounting for 11 percent of the total. This is more than twice the level we observed in the US over a similar period. The fact that the US and China have traded places, or at least traded trade shares, is not a fact that is well-known in the US and is likely to dramatically alter Japanese-US relations in the future.

Understanding the price impact of the expansion of Chinese exports is more complex. Although China plays a large role in Japanese imports, we find no evidence that import prices from China fell faster than those from other countries. In those categories where China already had a presence in 1992, we do not find that Chinese prices fell more rapidly than those of other exporters to Japan. Moreover, the impact of Chinese competition to other exporters is also small. There is no evidence that the entry of Chinese firms into new markets has any significant impact

on the pricing behavior of other exporting countries.[2] Clearly what is driving the rapid expansion

of Chinese exports into Japan is not lower prices for existing goods.

Given the large growth of varieties coming from China, it is possible that the popular

belief that China is exporting deflation is being driven by the constant introduction of cheap

Chinese products in Japanese markets. It is important to notice that the introduction of new

products would not be captured in existing price indexes which usually ignore product entry and

exit.[3,4] In order to identify the impact that a new product has on prices we need to understand its

welfare implications. Intuitively, the introduction of a new product reduces the cost-of-living for

consumers (i.e., the true price index) if the *price per quality* of the new product is *lower* than that

of existing products (i.e., higher quality or lower price than existing products) or if the new

product is sufficiently different from existing products that consumers value the additional

choice. Lower price per quality and higher variety of Chinese products could also explain the

large increase in Chinese shares in the recent period.

We use a CES aggregator to back out the implied impact of new products on the Japanese

cost-of-living. We find that there has been a remarkable decrease in the price per unit quality of

Chinese exports. Price per unit quality of Chinese exports halved during this period due largely

to quality upgrading. This is one of the most dramatic increases in quality that we observe in the

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[2] The impact of Chinese imports on the pricing of *domestic* competitors is beyond the scope of this paper. This might be an important channel through which Chinese imports affect Japanese prices, but a clean match between trade data and data on domestic prices is hard to obtain.

[3] This is a problem in the computation of most price indexes around the world, not only the Japanese import price index.

[4] To confirm that this is true in the Japanese case, we show that one can replicate the official import price index very closely using unit value data for the set of imports that are common throughout the period. This is strong evidence that the impact of new and better products is not captured in official statistics.

data. In other words, while prices of Chinese products as computed in official statistics are not falling by more than those of other exports to China, the quality of Chinese products is rising relative to those of other countries. However, we find the quantitative significance of this quality growth to be small. If the Japanese were to correct for the increase in quality in Chinese products in the import price index then the quality-adjusted import price inflation would only be 1 percentage points smaller than the actual import inflation over the 1992-2004 period.

While the specific price impact of new products from China is small, the impact of all new and higher quality imports can account for a fall in Japanese import prices of as much as 10 percentage points over the 1992-2004 period. This is smaller than the impact that new products had in the US and several other developed countries (see Broda and Weinstein, 2006) but still important given that the official import price index has been relatively flat over this entire period. However, given that imports are such a small share of Japan's overall consumption the deflationary impact of new imported goods in Japan's is still small, at around 1 percentage point throughout the entire period.[5]

In sum, China is not placing a strong deflationary impact on the actual Japanese import price index either directly through lower inflation of existing Chinese products or through competition to other Japanese exporters. Moreover, the magnitude of the effect of new goods from China in Japanese import prices is clearly deflationary but the effect is small. Taking into account all of Japan's new imported products, this effect can explain part of the perception that globalization is reducing import prices in Japan. Despite the large impact of new and better

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[5] This number is roughly coming from the fact that the import share of Japan is around 10 percent.

products in the quality-adjusted import price index, the low level of imports in consumption

suggest that the impact of globalization on consumer prices is still small in Japan.[6]

I. Japan's Trade with China

I. a. Overview

We first provide an overview of Japanese exports and imports. For our initial overview of

Japanese import and export data, we rely on the aggregates provided by the Japanese Ministry of

Finance.[7] Between 1988 and 2006, Japanese imports rose by 181 percent and Japanese exports

rose by 122 percent in nominal terms. Interestingly, imports from and exports to the US rose at

rates that were only a third as fast (46 and 47 percent respectively). By contrast exports to China

rose by 454 percent and imports from China rose by a whopping 810 percent. These numbers do

not simply reflect rapid growth from a low base. Of the 84 trillion yen worth of total new trade

that arose during this period, over one third was due to trade with China.

Figure 1 documents movements in the import structure of Japan. The figure makes clear

the very rapid change in position of the US and China. Although one cannot see it in the figure,

in 1975 Japan not only imported more from the US than China, it imported more from the US

than all of East Asia. East Asia gradually overtook China as a source of Japanese imports in the

late seventies, but the rise of imports from China did not really take off until 1990. Until 1998,

the rise of imports from China did not entail any deterioration in the share of imports emanating

from the US. Thereafter, the importance of the US as a Japanese trading partner entered a steep

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[6] An important channel that we do not explore in this paper is the exact quantitative role that globalization has on Japan's prices through the competitive pressure that imported goods put on *domestic* producers.

[7] http://www.customs.go.jp/toukei/info/index_e.htm

decline. Interestingly, all of the increase in imports from East Asia reflects the growth in imports from China. In fact the share of imports from East Asia excluding China (and Hong Kong) actually fell from 23 percent in 1988 to 22 percent by 2006. Thus the growth in imports from China was not matched by a more general growth in imports from East Asia more broadly.

One can observe a similar pattern in the export flows emanating from Japan as shown in Figure 2. Although Japanese exports to China have not overtaken those to the US, there is clear evidence of a dramatic change in the relative positions of the two countries. Between 1988 and 2006 the share of Japanese exports going to either China or the US stood a remarkably stable 42 percent. However, in 1988, 34 percent of Japanese exports were destined for the US as compared to only 23 percent by 2006. Thus, on both the import and export side one can observe a dramatic increase in the interdependency of the Japanese and Chinese economies.

Tables 1 and 2 report changes in the importance of the top 25 exporters to Japan by aggregating up 9-digit bilateral data supplied by the Japan Tariff Association. We shift to these data because it allows us to examine Japanese trade in far more detail than the MOF data. The top 25 exporters accounted for 88 percent of all Japanese imports in both 1992 and 2005. The rise in oil prices over this time period has dramatically increased the importance of countries like Suadia Arabia, United Arab Emirates, Iran, and Qatar as a source of imports. Other than shifts due to the rise in oil prices, there do not appear to be any substantial shifts in the relative rankings of East Asian sources of supply with the major exception of Hong Kong. Hong Kong appears to have fallen dramatically as a source of supply as goods are shipped from other locations in China. Interestingly, imports from the other growing giant, India, actually fell as a share of total Japanese imports by 30 percent, indicating that the remarkable recent growth in that country has not produced a comparable increase in exports to Japan.

I. b. Growth in Varieties

There are many ways in which one can define a "variety." In this paper we define varieties as in Broda and Weinstein (2006), i.e. the imports of a 9-digit HS good from a particular country. This definition is close to the concept first suggested by Armington (1969) and is consistent with a wide class of monopolistic competition models.

Table 3 documents that the number of varieties entering Japan rose by 32 percent between 1992 and 2005, i.e. from 71,666 varieties in 1992 to just under 95,000 varieties in 2005. There is always a question when using this definition of variety growth about how much of the growth can be attributed to an increase in the number of categories and how much is due to an increase in new varieties *per se*. As one can see from the table, the count of new varieties entering Japan rose 32 percent over this time period whereas the average number countries exporting a particular variety grew by 31 percent. Thus virtually all of the increase in new varieties imported by Japan can be ascribed to new sources of imports of particular 9-digit goods.

In Table 4, we report the relative contributions of different exporters to Japanese import variety growth. China's contribution is roughly double that of the next highest contributor over this time period, Vietnam. One of the things that is clear in this table is that although non-Chinese, East-Asian exporters did not expand their total exports to Japan dramatically over this time period, they did play a central role in the expansion of new varieties entering Japan. Just over a quarter of new varieties entering Japan came from these countries, and East Asia as a whole accounted for 37 percent of Japanese variety growth. By contrast, the number of varieties coming from the largest exporter to Japan over this time period, the US, actually fell slightly. Thus, the picture of what is happening with the number of varieties complements that of what

happened with imports as a whole – there was a substantial expansion of varieties from East Asia, and especially from China, and a relative decline of the importance of the US.

II. Implications for Japanese Prices

The preceding data preview suggests a number of important possibilities of the impact of globalization and Chinese exports in particular on Japan. In order to examine this, it is important to keep track of impacts arising from the price movements of existing goods and those of new goods entering Japan. To the extent that exports from China have driven down the price of existing imports relative to exports, this would be reflected as a terms of trade gain in Japan statistics. By contrast the availability of new imported products would tend to drive down Japanese prices but this effect would be mostly missed by official statistics. This happens as new varieties effectively constitute a fall in price from the reservation level to the observed level, but this fall in prices is ignored by most statistical offices around the world.

A goal of this paper is to examine the importance of these forces in the case of Japan. However, before we do so, we need to delve a little deeper into the data. One possible source of Japanese import data are the official import price indexes provided by the Bank of Japan. These indexes are based on a sample of 896 prices in the 1995 base index and 1601 prices in the 2000 index [Bank of Japan (2002)]. This is between 1-2 percent of the total number of unit values reported in the Japan Tariff Association data. Thus, the sample of prices used in the official index is much smaller than that universe of import prices. We will compare the Bank of Japan data with indexes derived using the data from the Tariff Association.

II. a. The Official Import Price Index

The Japanese import price index (IPI) is not constructed as a simple Laspeyres index. The Japanese import price index uses geometric averaging at the lower level and a Laspeyres index at the upper level. Oddly enough, this is not the same way as the Japanese CPI is computed.[8,9] Therefore, it is hard to make sense even of the most simple comparisons between import prices and consumer prices in Japan without taking explicit care of the fact that methodologies differ between indexes. In this section, we will explicitly make these adjustments. Another important characteristic of the Japanese import price index is that weights are not updated annually but at longer frequencies (most recently 1995 and 2000). This will give rise to differences between what are considered best-practice indexes formulas and official Japanese indexes.[10]

Finally, it is worth noting that the IPI, like most official indexes, cannot be used to assess the importance of new varieties entering Japan. The importance of this can be seen by examining the last four rows of Table 3. Only about two thirds of the varieties that were imported in 1992 were also imported in 2005 and similarly one third of the goods imported in 2005 were not imported in 1992. This underscores the importance played of new and disappearing varieties in import flows and suggests that an index based on a common set of goods is going to miss a lot of the implied price changes.

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[8] The US is also inconsistent in the construction of these indexes. The US CPI uses a geometric average at the lower level and a Laspeyres index at the upper level but the US IPI uses Laspeyres indexes at both levels (see BLS Chapter 15).

[9] Probably less surprisingly, there is also little consistency across countries in how price indexes are computed. For a thorough comparison of how US and Japanese prices are computed please see Broda and Weinstein (2007).

[10] It is also worth noting that the sample of price quotations that enter the Japanese IPI is not random. Prices quotes are chosen from close to 300 commodities. These commodities are import categories that constitute at least 0.5 percent of imports; thus, smaller import categories are excluded from the sampling procedure and hence the set of prices used in the index is not representative.

However, a major advantage of using the official data is that by defining products precisely, the official index avoids the problem that movements in unit values (all that is available in the Tariff Association data) reflect changes in the composition of underlying goods rather than changes in the prices themselves. Certainly it is easy to find in the data examples of wild unit value movements that almost surely reflect measurement issues, but these data problems have to be set against the fact that by working with unit value data, one can have access to a vastly broader set of price data. Moreover, by working with unit values one can also use comparable quantity data.

To further assess the relative costs and benefits of unit value versus official import price data we can compare the actual import inflation that would be implied from unit-value data in the recent years. In order to deal with data problems in the unit value data, we dropped observations where the ratio of the future price to the past price exceeds 3 or is less than 0.3. Figure 3 presents this comparison. Interestingly the price indexes computed using unit value data using the basic index formulas track the official index very closely. The correlation between the annual inflation rates between the unit-value index that uses a Laspeyres formula and the official index is 0.997, and 0.966 with the unit-value index that uses a geometric formula. This high correlation suggests that despite the noise in the unit values the index based on unit-values traces the official index very closely. In the rest of the paper, we will use this remarkable relationship as an important building block for understanding the impact that formula and variety changes can have on the Japanese import price index.

Given that a unit-value price index traces the official index so closely, we can derive what the import price index would look like if we were to use the same methodology as that underlying the Japanese CPI. Figure 4 shows the IPI using a Laspayres formula (just like the

CPI) and a number of other indexes –Fisher, Tornqvist, CES, Geometric, and Paasche – together with the official IPI. If the index were closer to a pure Laspeyres, like the Japanese CPI, it would have significant upward bias. The difference between the unit-value index based on a geometric average (which closely matches the official index) and the unit-value Laspayres index is a whopping 40 percent! This large difference underscores the importance of using the same methodology when making inferences between price indexes in a country (or across countries as in Broda and Weinstein (2007)).

According to the Bank of Japan website, between 1992 and 2002, import prices fell by 9 percent or almost 1 percent per year. Given that CPI inflation over this time period was zero in total, it is argued that dropping import prices had a significant impact on Japanese deflation. The problem with this comparison is that the CPI and the IPI use different methodologies in Japan. We believe that it is appropriate to compare the CPI and IPI that use a common methodology. The surprising conclusion is that the Japanese import price index based on the same methodology as the CPI *rose* by 15 percent over the same time period.[11] To the extent that Japanese consumers were substituting towards imports, the relatively *higher* price movements of imports should have served to prop up prices, not hold them down.[12]

The dispersion in the formula biases is also remarkable. One of the striking features of the plot is the behavior of prices between 1992 and 2002. Much of the inflation in Japanese import prices is driven by a very rapid increase in import prices at the end of the sample. If we

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[11] This reason for this difference can be traced to what is referred in the literature as the upper level substitution bias that is not corrected using a Laspayres index, but is accounted for using a geometric index.

[12] Similarly, the fact that the BLS's import and export price indexes are essentially pure Laspeyres indexes indicates that the different formulas used by international statistical agencies can produce substantially different pictures of what is happening to import prices.

focus on the period between 1992 and 2002, the time when MOF officials were making their statements, the drop in import prices is a bit more pronounced. Almost all of this drop occurred between 1997 and 2002. Thus there is some evidence that import prices were falling in Japan around the time that Japan entered deflation. Oddly enough, this entire drop reflects formula bias. Had the BOJ been using a superlative index, they would have realized that prices had actually been rising between 1992 and 2002 and even between 1997 and 2002. Between 1997 and 2002, prices didn't actually fall by 9 percent; they actually rose by 2 percent! Thus formula bias may be the reason why it appeared that Japanese deflation occurred at the same time as import price deflation.

Figure 4 also provides other interesting facts. Not surprisingly, the two superlative indexes, the Fisher and Tornqvist, yield almost identical rates of inflation. Perhaps more surprising is that the CES price index is also almost indistinguishable from the superlative indexes. This will be a useful fact that we will use later to argue that the variety bias using a CES aggregator is probably a reasonable approximation of the true bias.

These biases are summarized in Table 5. For each index, we express the bias in terms of the implied average annual inflation rate using that formula relative to the Tornqvist formula. Clearly, the choice of formula matters enormously. In 5 out of the 13 years between 1992 and 2005, the Tornqvist index differed from the official index in sign, this, in conjunction with the fact that the official index tracks the geometric index so closely suggests that the decision whether to use geometric averaging can qualitatively affect our understanding of what is happening to Japanese import prices. Nevertheless, no matter how we compute Japanese import price indexes using common goods, it appears that there is no clear declining trend in import prices.

II.b. Chinese Export Prices

It is possible that China is having an impact on Japanese import prices that is more subtle than what we can detect using aggregate import price indexes. China is often seen as a low cost competitor in many markets, and this is something that we can see clearly in our data. In Table 6 we report regressions in which we regress the log unit values on a dummy that equals 1 on if the source is China. We include HS-9 digit fixed effects in the first set of regressions and HS-4 digit fixed effects in the second set to control for cross product variation in prices. The coefficient on the China dummy corresponds to how much cheaper Chinese imports are than other imports in the same 9- or 4-digit category.

The results using the 9-digit dummies indicate that in 1992 Chinese exports to Japan were 0.896 log units cheaper than other exports in the same 9-digit category. This means that Chinese exports were 60 percent cheaper than other imports in the same narrowly defined category in 1992. By 2005, Chinese imports were even cheaper: 63 percent below the prices of imports of other countries.

We can see whether this relative decline in Chinese prices was due to declines in prices of existing Chinese exports or the entry of new cheaper products by looking at relative price declines between 1992 and 2005. Here again we drop unit values whose relative price movements are not in the interval [0.3, 3] and include HS-9 and HS-4 dummies. The data does not suggest that the prices of goods exported by China in 1992 fell at a faster rate than those exported by other countries over this time period. Essentially, the relative prices of Chinese prices show no relative decline compared to those of other countries in the same product

categories. This suggests that whatever is driving the rapid expansion of Chinese exports to Japan, it is not a general decline in prices charged by Chinese producers for existing goods.

These results differ from those of Schott (2007) who found that unit values of Chinese exports to the US declined substantially. This result seems to be due to the treatment of Hong Kong. In our data, if we treat Hong Kong and China as two different countries, we obtain an analogous result with Chinese prices falling significantly, but prices from Hong Kong rising significantly. These two forces cancel each other out and may reflect that the composition of goods passing through Hong Kong is changing, but that there is no significant change in Chinese exports broadly defined.

We have already seen that China has been playing a major role in the expansion of new varieties into Japan. One possible implication of this is that the entry of new Chinese products is that they are driving down the prices of other competing exporters. In order to examine this, we regressed the change in the log of the average price of the other exporters in a HS-9 digit category on whether a Chinese firm entered that sector or exited. We also include year-HS-4 interaction dummies to control for industry level variation that might be correlated with Chinese entry or exit.

In the first three columns of Table 7, we report the results from this exercise. When we do not include HS-4 year effects, we find that the entry of a Chinese exporter into a new market is associated with an 8 percent decline in the prices charged by other firms. However, when we include HS-4-year effects, this relationship looses statistical significance. Moreover, the exit of China from a Japanese import market is not associated with any increase in the relative prices of the other goods. In order to see whether the effect of Chinese entry or exit might take some time to have an impact on the prices of other producers, we also ran specifications in which we

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included one- and two-year lags of the entry and exit variables. Neither of these variables was significantly associated with a price change of imports of the other goods changed.

Our results from these exercises indicate that Chinese exports do not appear to have a differential impact on Japanese import prices when examined through conventional approaches. Chinese export prices into Japan are not falling faster than prices of other comparable 9-digit goods. Moreover, the entry or exit of a Chinese firm in a 9-digit sector does not tend to cause any significant movement in the prices of other firms.

III. The Variety Effect

The results from the previous section suggest that China has been a major contributor to the expansion in new varieties that have been entering the Japanese market over the last 15 years. In particular, China and other exporters that have entered the Japanese market could have an impact on inflation in Japan through the expansion of exported varieties. Common goods price indexes cannot measure the impact of new varieties on prices by definition. However, if we think about the entry of new goods as unmeasured price drops, and consumption goods are produced using these goods, it is possible that consumer prices might be falling as a result of the entry of new producers into the market.

We now turn to understanding this effect more clearly. Our estimation framework relies heavily on the work of Broda and Weinstein (2006), and we repeat some of their underlying theory here in an abbreviated format.

We begin by assuming that consumers purchase and derive utility from a final good U_t that is produced using domestic and foreign varieties.

$$(1) \qquad U_t = \left(D_t^{\frac{\kappa-1}{\kappa}} + M_t^{\frac{\kappa-1}{\kappa}} \right)^{\frac{\kappa}{\kappa-1}} ; \kappa > 1,$$

where M_t is the composite imported good to be defined below, D_t is the domestic good, and κ is the elasticity of substitution between both goods. Moving to the second tier, we define the composite imported good as:

$$(2) \qquad M_t = \left(\sum_{g \in G} M_{gt}^{\frac{\gamma-1}{\gamma}} \right)^{\frac{\gamma}{\gamma-1}} ; \gamma > 1$$

where M_{gt} is the sub-utility derived from the consumption of imported good g in time t, γ denotes the elasticity of substitution among imported goods, and G is the set of all imported goods. This sub-utility function can be represented by

$$(3) \qquad M_{gt} = \left(\sum_{c \in C} d_{gct}^{\frac{1}{\sigma_g}} \left(m_{gct} \right)^{\frac{\sigma_g-1}{\sigma_g}} \right)^{\frac{\sigma_g}{\sigma_g-1}} ; \sigma_g > 1 \ \forall g \in G ,$$

where σ_g is the elasticity of substitution among varieties of good g, which is assumed to exceed unity; for each good, imports are treated as differentiated across countries of supply, c [as in Armington [1969]]. That is, we identify varieties of import good g with their countries of origin. C is the set of *all* countries; d_{gct} denotes a taste or quality parameter for good g from country c.

Broda and Weinstein (2006) extend Feenstra (1994) to show proposition 2:

PROPOSITION 2: If $I_g \neq \varnothing \ \forall g \in G$ and $d_{gct} = d_{gct-1}$ for $c \in I_g \ \forall g \in G$, then the exact *aggregate* import price index with variety change is given by,

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$$(4) \qquad \Pi^M\left(\mathbf{p}_t,\mathbf{p}_{t-1},\mathbf{x}_t,\mathbf{x}_{t-1},I\right)=\frac{\phi_t^M\left(I_t,\mathbf{d}\right)}{\phi_{t-1}^M\left(I_{t-1},\mathbf{d}\right)}=CIPI(I)\prod_{g\in G}\left(\frac{\lambda_{gt}}{\lambda_{gt-1}}\right)^{\frac{w_{gt}}{\sigma_g-1}},$$

where

$$CIPI\left(I\right)=\prod_{g\in G}P_g\left(I_g\right)^{w_{gt}}$$

$$P_g\left(\mathbf{p}_{gt},\mathbf{p}_{gt-1},\mathbf{x}_{gt},\mathbf{x}_{gt-1},I_g\right)=\prod_{c\in I_g}\left(\frac{p_{gct}}{p_{gct-1}}\right)^{w_{gct}}$$

w_{gt} are log-change ideal weights, and

$$\lambda_{gt}=\frac{\sum_{c\in I_g}p_{gct}x_{gct}}{\sum_{c\in I_{gt}}p_{gct}x_{gct}} \quad\text{and}\quad \lambda_{gt-1}=\frac{\sum_{c\in I_g}p_{gct-1}x_{gct-1}}{\sum_{c\in I_{gt-1}}p_{gct-1}x_{gct-1}}.$$

In order to compute the impact of new varieties on the Japanese economy given by equation 12. We estimate the following system of import demand and export supply equations:

$$(5) \qquad \Delta^{k_{ig}}\ln s_{igvt}=-\left(\sigma_{ig}-1\right)\Delta^{k_{ig}}\ln p_{igvt}+\Delta^{k_{ig}}\varepsilon_{igvt}$$

$$(6) \qquad \Delta^{k_{ig}}\ln p_{igvt}=\frac{\omega_{ig}}{1+\omega_{ig}}\Delta^{k_{ig}}\ln s_{igvt}+\Delta^{k_{ig}}\delta_{igvt}$$

where $\Delta^{k_{ig}}x_{igvt}=\Delta x_{igvt}-\Delta x_{igk_{ig}t}$ (i.e., differencing across two different varieties of a given i-g pair), i denotes the import source country, g a 4-digit good, and v (for variety) a particular variety of good g, and $s_{igvt}=p_{igvt}x_{igvt}$. ε_{igvt} are taste or quality shocks to variety v of good g in country i and δ_{igvt} are shocks to the supply of the same variety. Our identification strategy is identical to that in Broda and Weinstein (2006).

IV. Results

IV. a. The Quality of Chinese Exports

Before we turn to estimating the bias in the Japanese import price index due to new varieties entering Japan, it is useful to examine what has been happening to the quality of imports by country. The first point to realize is that with the CES approach we have adopted, we can measure both the relative quality of new varieties as well as quality upgrading of existing varieties. The former is standard from earlier work, but the latter is new. To see how to measure quality upgrading of existing goods in the CES framework consider the CES demand function:

$$(17) \qquad s_{igvt} = \left(\frac{p_{igvt} / d_{igvt}}{P_{gt}} \right)^{1-\sigma_g} E_{gt}$$

where s_{igvt} is the share of expenditures on variety v in time t and E_{gt} is aggregate expenditure on good g in time t. If we take logs of equation (17), we obtain

$$(18) \qquad \ln s_{igvt} = \left(1-\sigma_g\right)\ln\left(\frac{p_{igvt}}{d_{igvt}} \right) + \ln\left(\frac{E_{gt}^{\frac{1}{1-\sigma_g}}}{P_{gt}} \right)^{1-\sigma_g}.$$

We can rewrite this as

$$\ln s_{igvt} = \phi_{gt} + \left\{ \left(1-\sigma_g\right)\ln\left(\frac{p_{igvt}}{d_{igvt}} \right) - \left[\overline{\left(1-\sigma_g\right)\ln\left(\frac{p_{igvt}}{d_{igvt}} \right)} \right] \right\},$$

where the terms with bars over them indicate the average for a good in time t.

In this case the term in curly brackets can be thought of as how movements in price per unit quality have been affecting market shares. In particular, if the price per unit quality is high for a given variety in a moment in time, this term will be positive. This suggests that if we

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regress the shares of products on HS-9 digit-year fixed effects, the residuals can be interpreted as how price per unit quality has been affecting the market share of that country. If we think that price per unit quality of the common exports have remained relatively constant over time, we should expect that this residual should not demonstrate any trend. However, if price per unit quality is falling, then we should expect to see this residual rise.

In order to see what was happening to these residuals, we estimated equation (18) and included country dummies so that each country's residuals would be normalized around 0.[13] We then plotted the mean and median residuals for the 9 largest non-oil exporters to Japan. The results are quite striking. For most countries, there is little movement in the mean or median residuals, however Chinese residuals exhibit a dramatic rise over time. Of the 100 largest exporters to Japan, China exhibits the highest increase in market share due to quality adjusted price movements. Chinese market share rose by a factor of 3.3 (1.2 log units) due to quality upgrading. By contrast of the 50 largest exporters to Japan, most experienced market share shifts due to quality adjusted price movements of less than plus or minus 26 percent. This suggests that a major reason for the increase in the intensive margin of Chinese exports is lower price per unit quality.

IV. b. Globalization and Japanese Prices

In order to estimate the impact of new varieties on Japanese prices as indicated by equation (12), we need to compute the lambda ratios and estimate the elasticities. To simplify the analysis, we define "goods" as HS-4 digit categories, which divides Japanese imports into just over one thousand categories.

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[13] Because of the size of the dataset, we limited our analysis to the 100 largest exporters to Japan in 1992.

Table 8 documents the summary statistics for the lambda ratios. In the typical sector the lambda ratio is 0.96. This implies that if all varieties entered utility symmetrically, then the number of varieties would have increased by about 4 percent over this time period. Most of the ratios are distributed relatively narrowly around this value however the distribution reveals that there are more sectors with substantial drops in the lambda ratio than sectors with substantial increases. This is consistent with the evidence we presented earlier indicating that on net there has been an increase in new varieties entering Japan.

The median lambda ratio for Japan is extremely close to Broda and Weinstein's (2006) computation of the lambda ratio for the US between 1990 and 2001 (0.95). Moreover the distribution of lamda-ratios is also quite similar. The 5th percentile in Japan is 0.35 compared to 0.34 in the US, and the 95th percentiles are 1.7 and 1.8 respectively. This suggests that the importance of new sources of supply have been approximately the same for the two economies. In particular, it suggests that even though China only accounted for one half the amount of net new variety growth in the US as in Japan, this did not change overall growth in new varieties in the two countries.

The distribution of elasticities of substitution is also quite similar to that obtained on US data. The median elasticity for Japanese imports is 2.9, which is the same value found in Broda and Weinstein (2006). However, the distribution of sigmas is somewhat more spread out for Japan with more elasticities taking on both large and small values. If we apply this elasticity estimate to the results of the previous section, then this implies that the price per unit quality fell by 0.63 (=1.2/1.9) log units or 47 percent over this time period. This suggests that the reason for the dramatic rise in Chinese exports is not price drops but rapid quality upgrading.

When we compute the magnitude of the new good bias as indicated by equation (12), we find it to be 6.1 percent between 1992 and 2005 or about 0.48 percent per year. This is actually somewhat smaller than Broda and Weinstein's (2006) estimate for the US between 1990 and 2001 (0.8 percent per year). This suggests that the impact of variety growth in Japan was, if anything, less than that in the US. In addition, the relatively small impact of variety growth on Japanese import prices indicates that the entry of low cost Chinese exporters cannot be having a substantial impact on Japanese prices. Given that Japan's imports of goods and services to GDP ratio averaged only 9 percent over this time period, the impact of a 0.5 percent per year bias in import prices on Japanese deflation is only 0.04 percent per year. If we were to assume that the growth in varieties in services did not match that of goods the impact would be smaller still. This indicates that there cannot be a large effect of new imported varieties in general, and China's entry into Japanese markets in particular, on aggregate Japanese prices.

V. Conclusion

The paper highlights the importance of using the same methodology across price indexes when making economic comparisons between them. Using the CPI methodology, the Import Price Index in Japan showed 20 percent inflation over the 1992-2002 as opposed to the -9 percent inflation measured using the official import methodology. This undermines statements that suggest a very strong component of import prices on the overall CPI deflation in Japan.

The paper also shows that Japan's proximity to China has meant that Japanese trade patterns have changed dramatically over the past fifteen years. The US is no longer Japan's primary trading partner as Japan trades far more with China than with the US. Much of the growth in Chinese exports can be traced to rapid quality per unit price improvements. However,

these very substantial changes in quality and expansion of China in new markets do not appear to have produced much of an impact on aggregate Japanese prices. In short, China does not seem to be exporting deflation to Japan.

References (Incomplete)

Armington, Paul, "A Theory of Demand for Products Distinguished by Place of Production", *International Monetary Fund Staff Papers*, XVI (1969), 159-78.

Broda, Christian, David E. Weinstein, "Globalization and the Gains from Variety", *Quarterly Journal of Economics*, Vol. 121, Issue 2 - May 2006..

Broda, Christian, David E. Weinstein, "Defining Price Stability in Japan: A View from America", NBER Working Paper No. 13255, July 2007.

Bank of Japan (2002) "Revision of the Wholesale Price Index (Switchover to the 2000 Base Corporate Goods Price Index CGPI)" Bank of Japan mimeo.

Schott, Peter K. (2006) "The Relative Sophistication of Chinese Exports" NBER Working Paper # 12173 April.

Figure 1: Share of Japanese Imports by Source Country or Region

—— East Asia　—— USA　—— China
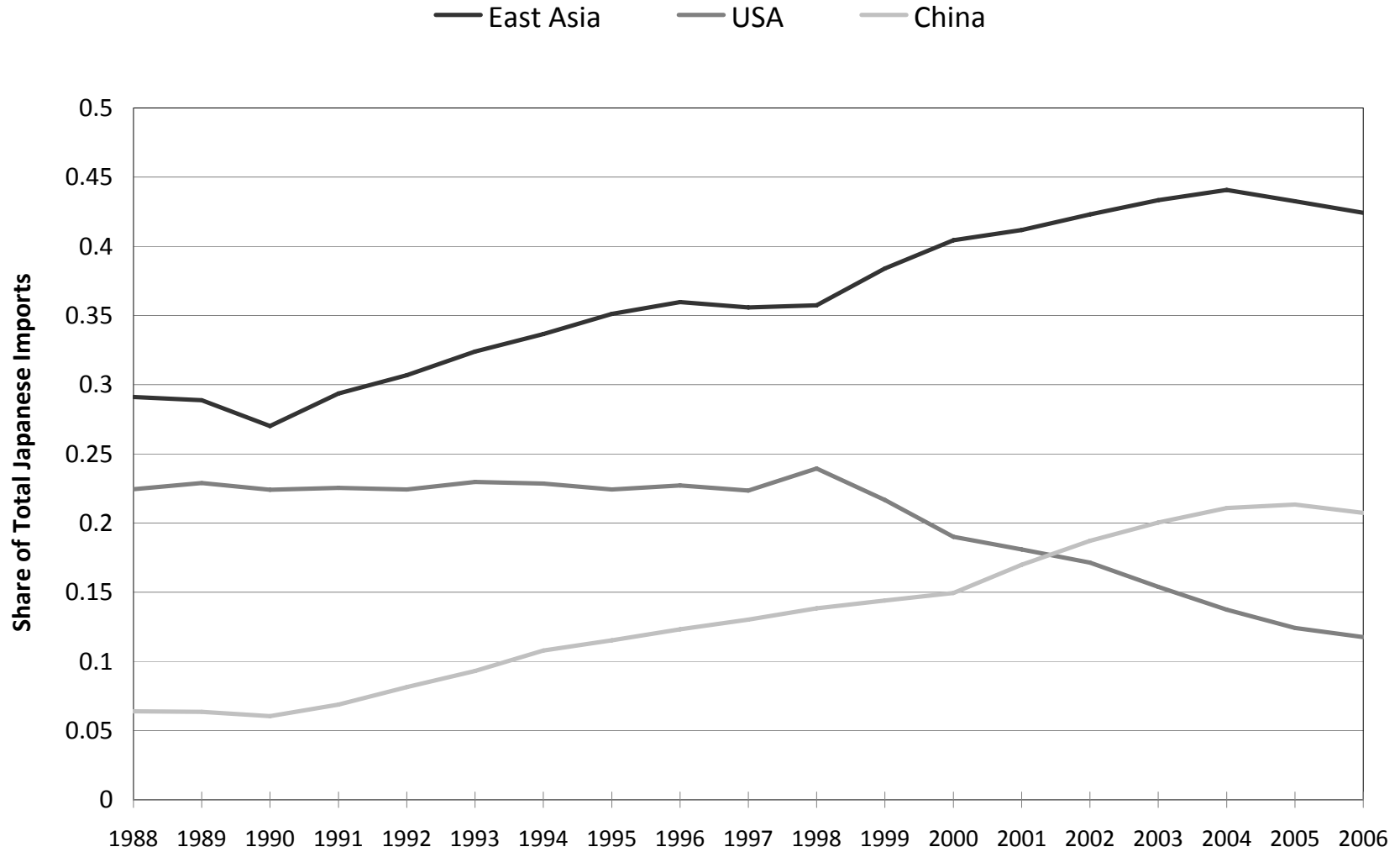
Figure 2: Share of Japanese Exports by Source Country or Region
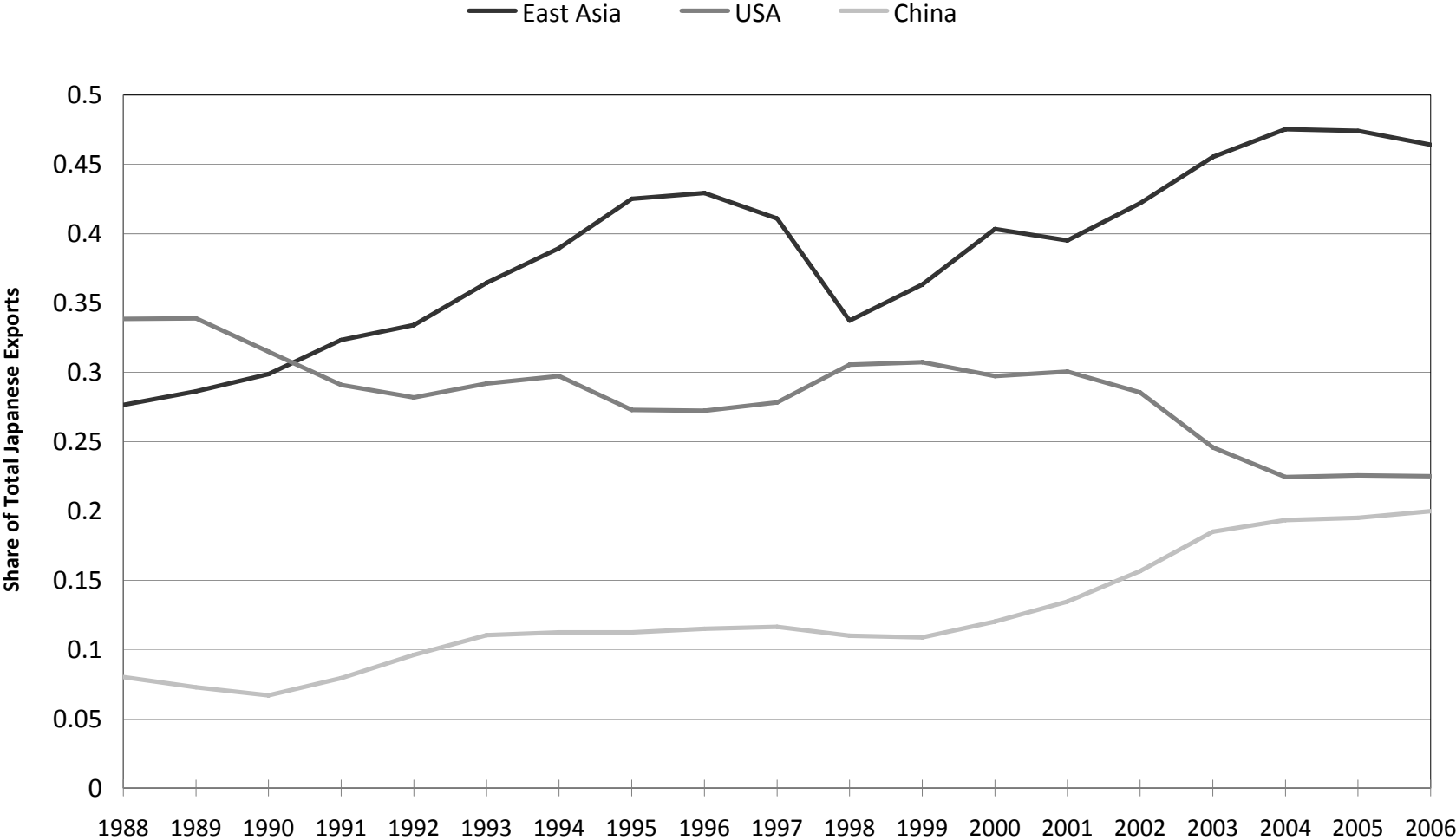
Figure 3: Laspeyres Index vs. Offical Import Price Index

- Official, including Chinese exports
- Laspeyres, including Chinese exports
- Laspeyres, excluding Chinese exports
- Geometric

Import Price Growth

20%
15%
10%
5%
0%
-5%
-10%
-15%

1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005
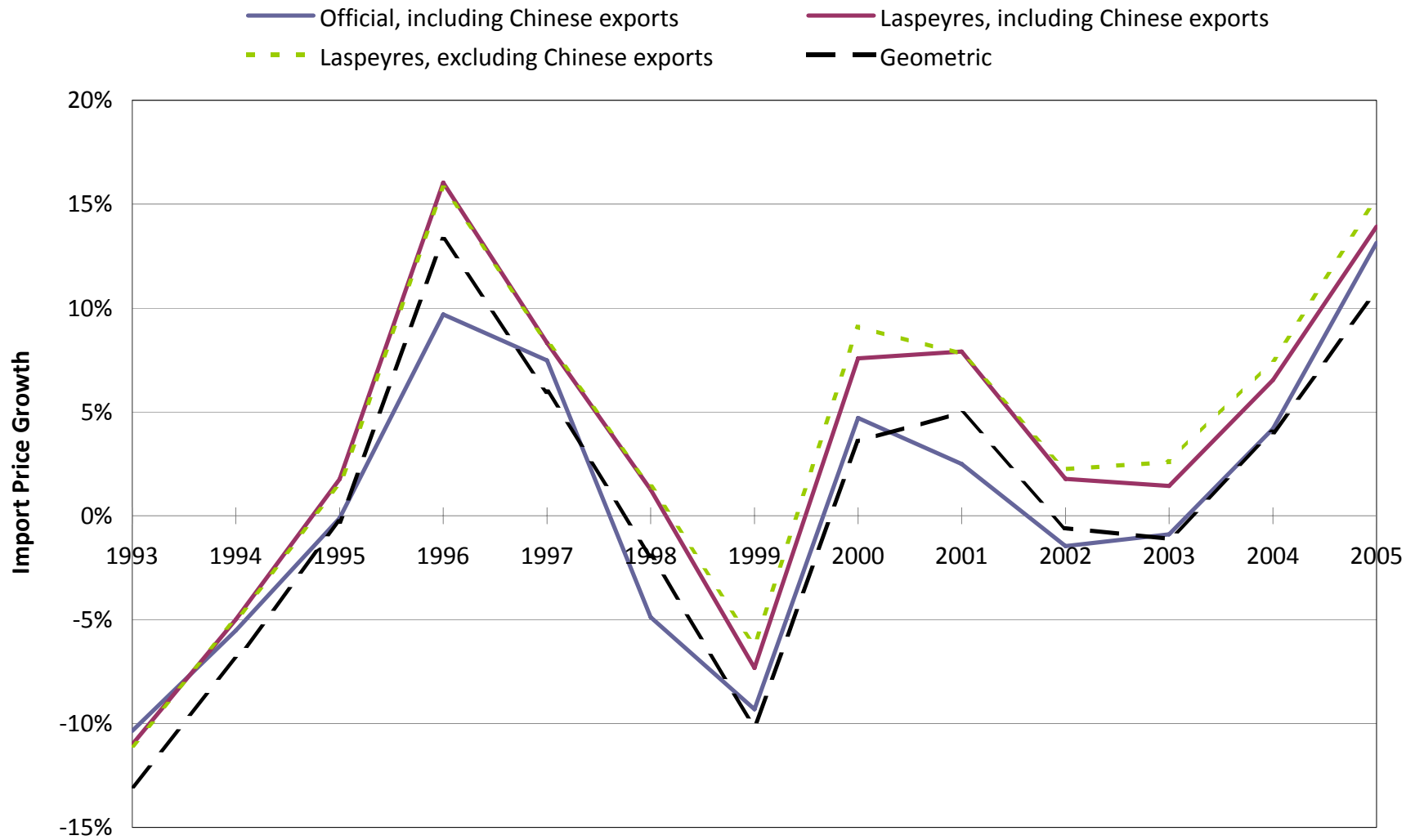
Figure 4: Formula Biases in Japanese Import Price Indexes
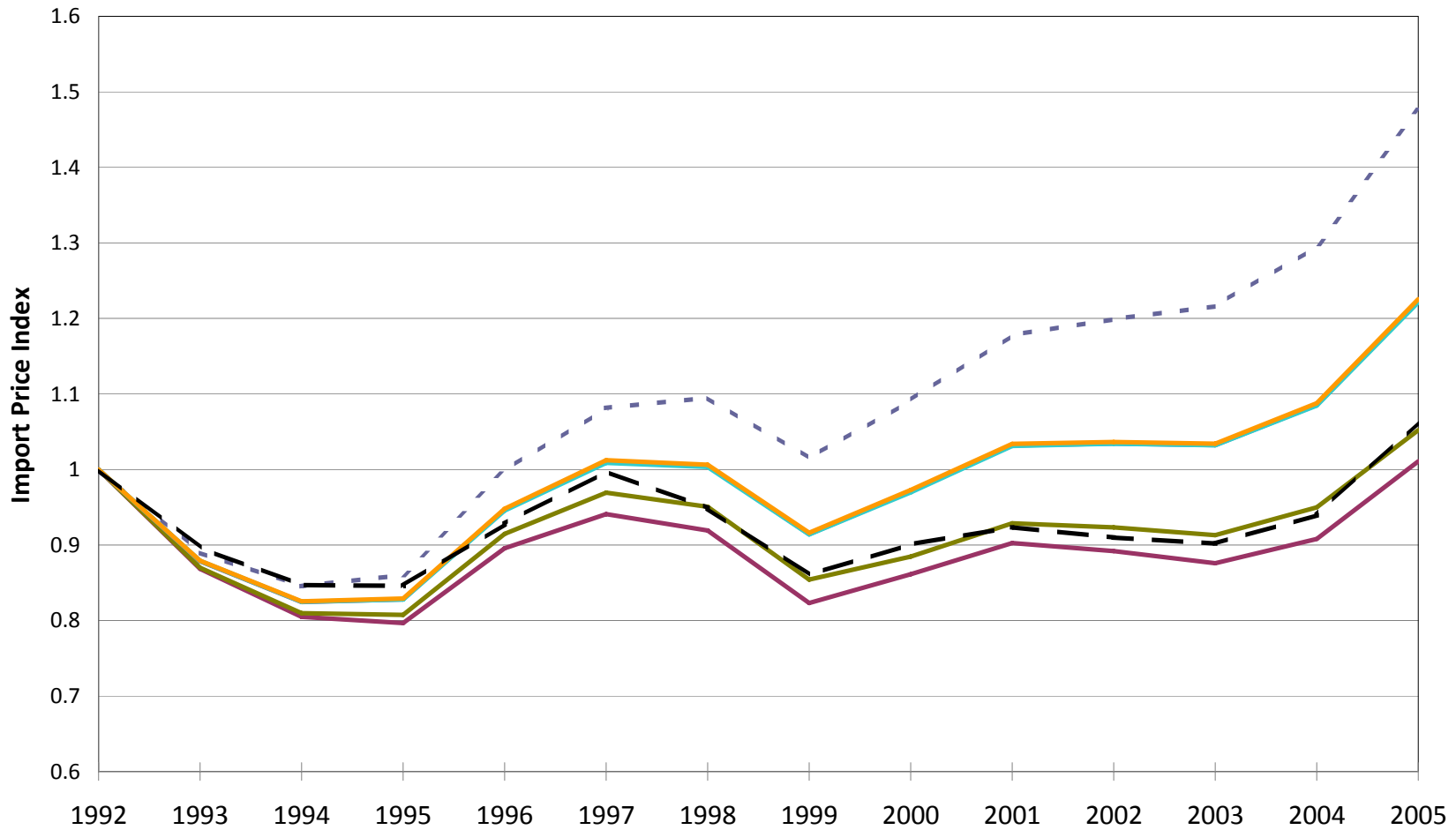
Figure 5: Mean Residuals for Goods Exported to Japan in All Years from 1992 to 2005
Top 9 Exporters to Japan in 1992 (Excluding OPEC Countries)

Graphs by Exporter Rank in 1992
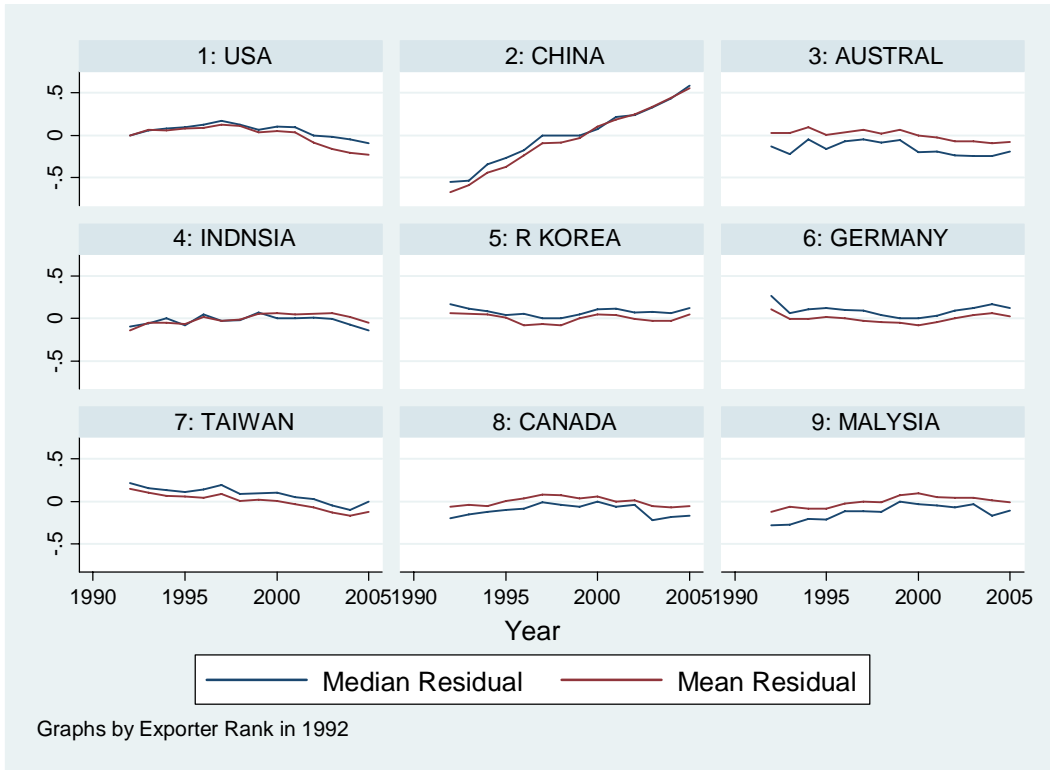
Residuals as from: xtreg lshr_adj, i(hsyear) fe, where lshr_adj = lshr - lshr_mean, where lshr is the log o
Source: Share Regressions v3.do

Table 1: Ranking in Terms of Goods Imported by Japan

| Country | Ranking in Year: | | | | Change |
	1992	1995	2000	2005	1992-2005
USA	1	1	1	2	-1
CHINA	2	2	2	1	1
AUSTRAL	3	4	7	5	-2
INDNSIA	4	6	5	7	-3
R KOREA	5	3	3	6	-1
GERMANY	6	7	10	9	-3
SU ARAB	7	12	9	3	4
U ARB E	8	10	6	4	4
TAIWAN	9	5	4	8	1
CANADA	10	8	12	14	-4
MALYSIA	11	9	8	11	0
THAILND	12	11	11	10	2
FRANCE	13	15	16	15	-2
U KING	14	13	14	19	-5
ITALY	15	16	19	18	-3
SWITZLD	16	18	23	24	-8
SNGAPOR	17	14	15	20	-3
BRAZIL	18	19	25	26	-8
IRAN	19	23	18	13	6
RUSSIAN	20	17	21	21	-1
PHILPIN	21	20	13	16	5
QATAR	22	31	17	12	10
HG KONG	23	25	36	39	-16
INDIA	24	22	29	28	-4
OMAN	25	34	33	29	-4

Table 2: Share of Total Japanese Imports
of the Top 25 Exporters in 1992

Country	Share of Japanese Imports in Year:				Change
	1992	1995	2000	2005	1992-2005
USA	0.224	0.224	0.190	0.124	-0.100
CHINA	0.073	0.107	0.145	0.210	0.138
AUSTRAL	0.053	0.043	0.039	0.048	-0.006
INDNSIA	0.052	0.042	0.043	0.040	-0.012
R KOREA	0.050	0.051	0.054	0.047	-0.002
GERMANY	0.046	0.041	0.034	0.035	-0.012
SU ARAB	0.044	0.029	0.037	0.056	0.012
U ARB E	0.042	0.030	0.039	0.049	0.007
TAIWAN	0.041	0.043	0.047	0.035	-0.006
CANADA	0.033	0.032	0.023	0.017	-0.016
MALYSIA	0.028	0.031	0.038	0.028	0.000
THAILND	0.026	0.030	0.028	0.030	0.005
FRANCE	0.023	0.020	0.017	0.017	-0.007
U KING	0.021	0.021	0.017	0.013	-0.008
ITALY	0.018	0.019	0.014	0.013	-0.005
SWITZLD	0.014	0.012	0.009	0.010	-0.004
SNGAPOR	0.013	0.020	0.017	0.013	0.000
BRAZIL	0.012	0.012	0.008	0.009	-0.004
IRAN	0.011	0.008	0.014	0.020	0.009
RUSSIAN	0.010	0.014	0.012	0.012	0.002
PHILPIN	0.010	0.010	0.019	0.015	0.005
QATAR	0.009	0.006	0.015	0.021	0.011
HG KONG	0.009	0.008	0.004	0.003	-0.006
INDIA	0.009	0.009	0.007	0.006	-0.003
OMAN	0.008	0.006	0.005	0.005	-0.003

Table 4: Country Contribution to Growth in Japanese Varieties

Country	1992-1998 Contribution	1992-1998 Average Share of Japanese Imports	1999-2005 Contribution	1999-2005 Average Share of Japanese Imports	1992-2005 Contribution	1992-2005 Average Share of Japanese Imports
CHINA	9.3%	10.5%	11.8%	17.8%	11.2%	14.2%
VIETNAM	5.3%	0.5%	6.6%	0.8%	6.2%	0.6%
THAILND	4.0%	2.8%	4.9%	3.0%	4.6%	2.9%
INDIA	3.2%	0.9%	5.1%	0.6%	4.4%	0.7%
INDNSIA	4.8%	4.6%	2.6%	4.2%	4.3%	4.4%
R KOREA	4.2%	4.7%	2.7%	4.9%	4.2%	4.8%
PHILPIN	3.6%	1.2%	1.5%	1.8%	3.0%	1.5%
MALYSIA	3.5%	3.1%	1.4%	3.4%	2.9%	3.3%
MEXICO	2.9%	0.5%	2.4%	0.5%	2.7%	0.5%
ITALY	2.3%	1.8%	3.3%	1.5%	2.6%	1.7%
SPAIN	2.4%	0.4%	2.7%	0.4%	2.5%	0.4%
BELGIUM	2.4%	0.6%	2.3%	0.5%	2.2%	0.5%
ISRAEL	2.3%	0.3%	1.5%	0.2%	1.9%	0.3%
BRAZIL	0.7%	1.1%	4.0%	0.8%	1.9%	1.0%
CANADA	3.4%	3.1%	-0.3%	2.1%	1.8%	2.6%
AUSTRAL	2.4%	4.7%	-0.1%	4.2%	1.4%	4.4%
AUSTRIA	1.3%	0.3%	1.7%	0.3%	1.3%	0.3%
FINLAND	1.8%	0.3%	1.0%	0.3%	1.3%	0.3%
TAIWAN	1.8%	4.0%	0.8%	4.0%	1.2%	4.0%
NETHLDS	1.8%	0.6%	-0.2%	0.5%	0.9%	0.6%
FRANCE	2.2%	2.0%	-0.5%	1.8%	0.9%	1.9%
RUSSIAN	0.1%	1.2%	2.2%	1.2%	0.8%	1.2%
DENMARK	0.9%	0.6%	1.4%	0.6%	0.8%	0.6%
S AFRCA	0.7%	0.8%	1.4%	0.9%	0.7%	0.8%
U ARB E	0.7%	3.5%	0.7%	3.8%	0.7%	3.6%
SNGAPOR	1.1%	1.7%	-0.5%	1.5%	0.7%	1.6%
NEWZELD	0.6%	0.7%	0.7%	0.6%	0.7%	0.6%
PERU	0.5%	0.1%	0.6%	0.1%	0.6%	0.1%
ARGENT	0.1%	0.2%	1.1%	0.1%	0.5%	0.1%
SWEDEN	0.8%	0.7%	-0.2%	0.6%	0.5%	0.6%
IRAN	0.5%	1.0%	0.2%	1.6%	0.5%	1.3%
NORWAY	1.2%	0.3%	-0.8%	0.3%	0.5%	0.3%
CHILE	0.3%	0.8%	0.5%	0.8%	0.4%	0.8%
IRELAND	1.4%	0.6%	-0.5%	0.9%	0.4%	0.8%
COLMBIA	0.3%	0.1%	0.2%	0.1%	0.3%	0.1%
PAKISTN	0.3%	0.2%	0.4%	0.1%	0.2%	0.1%
PRTRICO	0.2%	0.1%	0.0%	0.2%	0.2%	0.2%
GERMANY	0.9%	4.0%	0.1%	3.6%	0.1%	3.8%
U KING	2.0%	2.1%	-1.5%	1.6%	0.1%	1.9%
OMAN	0.2%	0.6%	0.0%	0.6%	0.1%	0.6%
BRUNEI	0.1%	0.5%	0.0%	0.4%	0.1%	0.4%
QATAR	0.0%	0.8%	0.1%	1.6%	0.1%	1.2%
KUWAIT	0.2%	0.8%	-0.2%	1.2%	0.1%	1.0%
PAP NGA	-0.1%	0.2%	0.2%	0.1%	0.1%	0.1%
NIGERIA	0.1%	0.0%	0.0%	0.2%	0.0%	0.1%
SU ARAB	0.4%	3.3%	-0.4%	3.8%	0.0%	3.6%
VENEZLA	0.0%	0.1%	-0.1%	0.1%	0.0%	0.1%
USA	2.1%	22.8%	-2.9%	16.8%	-0.1%	19.8%
SWITZLD	-0.3%	1.1%	1.1%	1.0%	-0.2%	1.1%
HG KONG	-0.5%	0.8%	-0.7%	0.4%	-0.8%	0.6%

Note: Countries are ranked by average share of Japanese imports from 1992 to 2005.

Table 5: Formula Biases of Import Price Indexes

	Laspeyres	Paasche	Geometric	CES	Fisher	Official
Median Bias of Index Relative to Tornqvist	1.5	-1.5	-1.0	0.0	0.0	-1.1
Standard Dev. of Measurement Error	0.2	0.2	0.5	0.0	0.1	1.9

Table 6: Regressions of Prices and Price Variation Against a Dummy Variable Indicating China's Presence in the Market

	Fixed Effects Controlling for 9 Digit HS Code Variation				Fixed Effects Controlling for 4 Digit HS Code Variation			
	$LN(P_{1992})$	$LN(P_{2005})$	$LN(P_{2005}/P_{1992})$	P_{2005}/P_{1992}	$LN(P_{1992})$	$LN(P_{2005})$	$-N(P_{2005}/P_{1992})$	P_{2005}/P_{1992}
China Dummy	-0.896	-1.009	0.018	0.023	-0.983	-0.983	0.021	0.024
	[0.020]	[0.018]	[0.015]	[0.020]	[0.026]	[0.022]	[0.014]	[0.019]
Constant	1.748	1.482	-0.032	1.22	1.754	1.48	-0.032	1.22
	[0.005]	[0.005]	[0.004]	[0.005]	[0.007]	[0.006]	[0.004]	[0.005]
Observations	57595	80671	29230	29230	57595	80671	29230	29230
Number of 9 digit HS Codes	7432	8135	4648	4648				
Number of 4 digit HS Codes					1224	1234	1026	1026
R-squared	0.04	0.04	0	0	0.02	0.03	0	0

Standard errors in brackets
Source: China 4.do

Table 8: Distribution of Lambda Ratios and Sigmas

Percentile	Lamda Ratio	Sigma
1%	0.07	1.25
5%	0.35	1.48
10%	0.57	1.64
25%	0.84	2.07
50%	0.96	2.93
75%	1.03	4.76
90%	1.27	11.43
95%	1.68	25.03
99%	5.18	108.19
N. Obs.	1074	1074

0.99517
0.00549