Reverse Imports, Foreign Direct Investment and The Exchange Rate

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Abstract

This paper investigates systematic linkages among "reverse imports", foreign direct investment, and exchange rates. We have in mind the competition in the Japanese market of a Japanese multinational firm and a Chinese domestic firm. Products are differentiated based on Japanese consumers' brand name recognition and retail barriers in Japan. The model shows that the appreciation of the Yen leads to an increase in Japanese FDI in China and "reverse imports", and a decrease in Japanese domestic production. Due to the barriers in brand name and the distribution system, the exports of the Chinese firm may fall, because the increase of reverse imports may erode the market share of Chinese firm, even though total exports from China increase. The predictions of the model fit well with the actual data. In addition, we find that Yen appreciation may improve the profits of the Japanese firm and welfare in Japan under reverse imports, against conventional wisdom.

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1. Introduction

China's exports have experienced two-digit growth rates in the past decade. "Made in China" is available almost in every corner of the global market, and is occupying increasing market share, which traditionally belonged to other foreign competitors. What are the reasons for the sudden popularity of "Made in China"? Observers may point to the relatively low labor cost as a secret of success. However, many other developing countries are ready to provide their goods at even lower prices, such as Cambodia, India and Vietnam, etc. Why aren't they as successful? Further, labor in China was even cheaper ten years ago compared with that of today. Why was "Made in China" not popular then?

Another fact is, it is very difficult for firms from a developing country to penetrate the markets of industrialized countries, even if their products are of equal quality. This can be traced to at least a couple of reasons. First, the products from developing countries lack brand name recognition, which is important for sophisticated consumers in the industrialized countries. Second, compared with firms in the industrialized countries, those from the developing countries do not have internationally established distribution and marketing networks, making market access even harder.

Given the intense competition from other developing countries and the many barriers in the industrialized countries, it becomes more important to find alternative explanations for the sudden success of "Made in China." These explanations should go beyond China's comparative advantage in labor-intensive goods, which other developing countries also possess.

The present paper sets out to undertake this task. We have in mind Japanese subsidiaries producing in China and then importing back to Japan for consumption, i.e., the

phenomenon of “reverse imports”. One Chinese and one Japanese firm compete in the Japanese market. The Japanese firm can also produce in China. Products are differentiated due to brand name recognition, and distribution and marketing barriers. We find that exchange rate changes, wage differentials, and barriers in brand name as well as retail systems contribute to increases in Japanese outward FDI and reverse imports.

Specifically, the appreciation of the Yen leads to an increase in Japanese FDI in China and “reverse imports”, and a decrease in Japanese domestic production. Due to the barriers in brand name and the distribution system, the exports of the Chinese firm may fall, because the increase of reverse imports may erode the market share of Chinese firm, even though total exports from China increase. Depending on product differentiability, the combination of Yen appreciation and market barriers against foreign products decreases production in Japan and helps the Chinese firm to gain market share. In addition, Yen appreciation may improve the profits of the Japanese firm and welfare in Japan under reverse imports, which is contrary to conventional wisdom.

It is also counter intuitive that market barriers against foreign products in Japan help the Chinese firm to gain market share. However, this arises under the possibility of reverse imports and Yen appreciation. The logic is as follows. Yen appreciation helps the Japanese firm to gain an edge on the Chinese firm in acquiring cheaper Chinese inputs. It follows that Japanese FDI and reverse imports increase. If market barriers are low, then these increased reverse imports substitute outputs made by the Chinese firm. However, if market barriers are high enough, then markets become segmented to some extent. As a consequence, reverse imports replace products made in Japan instead of those by the Chinese firm, which leads to higher market share for the Chinese firm under Yen appreciation.

The predictions of the model fit well with the actual data. The sudden popularity of "Made in China" can be ascribed to China's devaluation at the early 1990s, in addition to other factors. The devaluation of Chinese Yuan reduced the input cost and improved the relative wealth of foreign investors, eventually leading to more FDI inflows and higher direct exports and reverse imports to other countries. In 2001, more than 50 percent of China's exports are produced by foreign firms in China, equivalent to $2 of FDI generating $1 of exports. In other words, it is the influx of export-oriented FDI, which shifts the demand originally served by the source countries or other host countries, to "Made in China".

There are numerous studies on China's FDI boom, for instance, Lardy (1995), Henly et al (1999) and Zhang (2001), etc. They identify potential market size, low labor cost, preferential policies (e.g., tax credits), openness, geographic proximity, and political stability as primary factors attracting FDI. However, the role of exchange rate fluctuations has been neglected, and the phenomenon of reverse imports has not been investigated, to the best of our knowledge.

While traditional theories say that exchange rate changes do not affect FDI flows, recent works have shown that they are interdependent (see Feenstra, 1999, for an excellent survey). Essentially, there are two channels through which currency devaluation impacts FDI inflows: a wealth effect and a relative production cost effect, both benefiting the foreign investor and leading to more FDI inflow. Theoretical models in this strand include Kohlhagen (1977), Cushman (1985), and Froot and Stein (1991), and a few empirical studies provide evidence supporting the theoretical arguments, see for instance, Klein (1994), and Goldberg and Klein (1997). Blonigen (1997) argues that Japanese FDI into the U.S. during 1985-1990 were motivated by the desire to acquire the knowledge assets of U.S. firms, in

addition to the low value of the U.S. dollar. As a complement to this literature, the present paper shows that reverse imports are another means through which exchange rate fluctuations can affect FDI flows.

The rest of the paper is organized as follows. Section 2 presents some stylized facts on reverse imports, exchange rates, and Japanese FDI in China; section 3 sets up the basic model, section 4 derives the equilibrium and its properties, section 5 looks into the conditions for FDI and reverse imports to arise, section 6 investigates the impacts of exchange rate changes on profits and welfare, and section 7 provides concluding remarks.

2. Some Stylized Facts on FDI, Exchange Rates and Exports in China

Stylized Fact #1: The contribution of foreign invested firms to China's exports

In 2001, the exports of foreign invested firms in China amounted to $133.23 billion, just above 50 percent of China's total exports (China Statistics Yearbook, 2002). It is the first time that foreign invested firms exported more than China's domestic firms. As a matter of fact, the sustained high growth of China's exports is largely attributed to the outstanding performance of foreign invested firms rather than the expansion of domestic firms. Figure 1 compares the export performance of China's domestic firms with that of foreign invested firms in China, along with China's total exports, for the period of 1994 to 2001. Even though domestic firms' exports rose from $86.3 billion in 1994 to $132.92 billion in 2002, it declined sharply in 1996. The two-digit growth in 1997 simply brought the exports of the domestic firms to the level of 1995. Affected by the Asian financial crisis, the exports of domestic firms experienced another downturn in 1998 and slow growth in 1999. As a result, the exports of domestic firms averaged about 6.4 percent annually from 1994 to 2001, even

lower than the average growth rate of China's GDP in the same period. On the other hand, the exports of foreign invested firms showed much higher and more consistent growth during the period. It rose to $133.32 billion in 2001, more than four times higher than the level in 1994. On average, the exports of foreign invested firms grew 21.2 percent, much higher than the growth of China's total exports in the same period. The empirical evidences indicate that the exceptional growth of China's exports largely relies on the robust growth of foreign invested firms.

Stylized Fact #2: The correlation between Japanese FDI and the real exchange rate

Figure 2 outlines the trends of Japanese FDI in China and the real exchange rate between Yen and Yuan from 1980 to 2001. It is straightforward to see that there exists a significant correlation between them. As Yen appreciated, Japanese FDI inflow rose. In particular, when the depreciation of Yen started in late 1994, it was followed by a sharp drop of FDI inflow from 1996 to 1998. Contrary to conventional thinking, which claims that the decline of Japanese FDI in China is due to the Asian financial crisis, the Japanese FDI in China's manufacturing actually started to decline in 1996, one and half years earlier than the Asian financial crisis! The sharp decline in FDI was the direct result of the weakened Yen. As Yen appreciated in 1998, Japanese FDI started to climb again. All these imply that there must exist a non-coincidental relationship between the exchange rate and FDI.

Stylized Fact #3: High shares of reverse imports in Japanese affiliates in China

One of the most important markets for Japanese affiliates in China is Japan itself. Yen appreciation raises the relative production cost in Japan, driving production to low cost

countries through FDI and importing back for serving the Japanese domestic market. Figure 3 presents the quarterly trends of reverse imports of Japanese affiliates in China, in selected manufacturing sectors: industrial machinery, electrical machinery, precise machinery, and transportation equipment. These are the sectors that Japanese industrial competitiveness holds strong globally. Since the last quarter of 1996, the share of reverse imports in electrical machinery has been more than 20 percent. Corresponding shares in the other three sectors are much higher, and have experienced significant increases. For precise machinery, it increased from 49 percent in the last quarter of 1996 to 61 percent in the third quarter of 2002; for transportation equipment, it rose from 19 percent in 1996 to more than 45 percent in the last quarter of 2002; for industrial machinery, it rose to 57 percent from 49 percent during the same period. Close examination reveals that except for the period right after the Asian financial crisis, reverse imports across all sectors showed a rising trend. The decline of reverse imports during the Asian financial crisis was due to the weak import demand in Japan, caused by the sharp Yen depreciation in the same period.

3. Basic Model Setup

3.1 Consumer Demand

Consider the Japanese market as oligopolistic, with two firms competing à la Cournot. A typical Japanese consumer consumes a numeraire good *m*, and three differentiated goods: *x*, *y*, and *z*. Good *x* is made by a Chinese firm and sold under Chinese brand, good *y* is made by a Japanese firm in China and sold under Japanese brands, and good *z* is also made by the Japanese firm, but in Japan. All goods are sold in Japan only. Thus, China's total exports to Japan is $x+y$.

The products made in Japan have the highest recognition in both brand name and quality. In contrast, the goods made by the Chinese firm and sold under its brand name have low acceptance by Japanese consumers, due to problems of brand recognition. They are usually considered as low quality goods as well, compared with those made in Japan or by the Japanese firm in China. In addition, these products have less access to the Japanese retail and distribution systems.

The goods made by the Japanese firm in China and sold under Japanese brand names enjoy much better access to the Japanese market. They also benefit from consumer's brand recognition. However, since they are made in China, Japanese consumers still consider them as lower quality compared with those made in Japan.

Given the above, the typical consumer can be assumed to maximize the following utility function:

$$V(m,x,y,z) = m + U(x,y,z)\,, \tag{1}$$

subject to $p_x x + p_y y + p_z z + m = I$, where

$$U(x,y,z) = ax + by + cz - \frac{1}{2}(x^2 + y^2 + z^2) - (\gamma_1 xz + \gamma_2 xy + \gamma_3 yz)\,. \tag{2}$$

In (2), we assume that $0<a<b<c$ and $0<\gamma_1<\gamma_2<\gamma_3<1$, which hopefully capture the preferences of the Japanese consumers roughly. We now turn to their implications.

Maximization of the consumer's problem in (1) subject to the constraint yields the inverse demand functions for goods *x*, *y*, and *z* in units of good *m*.

$$p_x = a - x - (\gamma_2 y + \gamma_1 z)\,, \tag{3a}$$

$$p_y = b - y - (\gamma_2 x + \gamma_3 z), \tag{3b}$$

$$p_z = c - z - (\gamma_1 x + \gamma_3 y). \tag{3c}$$

The assumption $0<a<b<c$ implies that for any given price, consumers demand good *x* the least, good *y* the second least and good *z* the most. This is consistent with consumers' brand recognition in Japan. In addition, the parameter γ_1 indicates the substitutability between goods *x* and *z*, γ_2 does the same between goods *x* and *y*, and γ_3 between goods *y* and *z*. The assumption $0<\gamma_1<\gamma_2<\gamma_3<1$ implies: (i) the three goods are imperfect substitutes; (ii) goods *x* and *z* are most differentiated, *x* and *y* are second most differentiated, and *y* and *z* are least differentiated. If $\gamma_i = 0$, there is zero substitutability; and if $\gamma_i = 1$, there is perfect substitutability. We assume that these two special cases do not arise in the present model.

3.2 Production

On the production side, we assume that labor is the only input. All firms have identical technology: one unit of input produces one unit of output. The reason for this assumption is that we want to focus on market segmentation based on brand recognition, i.e., products separated by consumer preferences, ignoring possible explicit differences in production technology.

Let the wage rates in China and Japan be $w_i, \quad i = C, J$. Then the profit function of the Chinese firm can be written as

$$\pi_C = (p_x - e w_C) x, \tag{4}$$

where *e* denotes the exchange rate, i.e., the price of the ChineseYuan in terms of the Japanese Yen. The exchange rate enters because the firm's wage cost is paid in the Chinese currency. We assume that $ew_C < w_J$, i.e., the Chinese wage is lower than the Japanese wage expressed in the Japanese Yen.

The profit function of the Japanese firm consists of two parts: the sum of those from Japan as well as from China.

$$\pi_J = \{p_z - w_J\}z + (p_y - ew_C)y\,. \tag{5}$$

4. The Equilibrium and Its Properties

4.1 The Equilibrium

The two firms compete in a Cournot fashion. The equilibrium is determined by choosing outputs to maximize profits. For the Chinese firm, substituting (3a) into (4) and maximizing it with respect to *x* yields the following first order condition:

$$a - 2x - (\gamma_2 y + \gamma_1 z) - ew_C = 0\,. \tag{6a}$$

Simultaneously, the Japanese firm chooses *y* and *z* to maximize (5). The FOCs are

$$b - 2y - (\gamma_2 x + 2\gamma_3 z) - ew_C = 0\,, \tag{6b}$$

$$c - 2z - (\gamma_1 x + 2\gamma_3 y) - w_J = 0\,. \tag{6c}$$

For any given (e, w_C, w_J, γ_i), $i = 1, 2, 3$, conditions (6a), (6b), and (6c) jointly determine a unique solution (x, y, z), which is a Nash equilibrium.

4.2. Comparative Statics Analysis

Total differentiation of conditions (6a-6c) yields the following matrix.

$$-\begin{pmatrix} 2 & \gamma_2 & \gamma_1 \\ \gamma_2 & 2 & 2\gamma_3 \\ \gamma_1 & 2\gamma_3 & 2 \end{pmatrix} \begin{pmatrix} dx \\ dy \\ dz \end{pmatrix} = w_C \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix} de \tag{7}$$

The determinant of the matrix is $\Delta = 2(\gamma_1^2 + \gamma_2^2 + 4\gamma_3^2) - 4\gamma_1\gamma_2\gamma_3 - 8 < 0$. From (7), some interesting comparative statics results can be derived.

$$\frac{\partial y}{\partial e} = [2\gamma_1\gamma_3 + 4 - (\gamma_1^2 + 2\gamma_2)] w_C / \Delta < 0, \tag{8a}$$

$$\frac{\partial z}{\partial e} = [(2\gamma_2\gamma_3 - 4\gamma_3) + (\gamma_1\gamma_2 - 2\gamma_1)] w_C / \Delta > 0, \tag{8b}$$

$$\frac{\partial x}{\partial e} = 2[2(1 - \gamma_3^2) + (\gamma_1\gamma_3 - \gamma_2)] w_C / \Delta. \tag{8c}$$

Proposition 1: *An appreciation of the Yen leads to (i) an increase in Japanese FDI and output in China, and (ii) a decrease of output in Japan.*

Proof: Self evident from (8a) and (8b). QED

The increased Japanese output in China, which is eventually exported to Japan, is the so-called "reverse imports", in the sense that it is produced in China by the Japanese firm, but imported back to Japan for consumption.

From proposition 1, the reason that exchange rate movements affect FDI inflows in the present model is the existence of "reverse imports." Through FDI, the Japanese firm can take advantage of Yen appreciation by buying Chinese labor more cheaply, enabling it to gain an edge over the Chinese firm (which buys Chinese labor with the Chinese currency). In the absence of reverse imports (as in traditional models), then products are sold in China and profits are repatriated back to Japan. In this case, Yen appreciation does not benefit the Japanese firm after profits are repatriated in Yen.

Condition (8c) implies the following:

Proposition 2: *An appreciation of the Yen leads to an increase (respectively decrease) in the exports of the Chinese firm if* γ_2 *is sufficiently small (respectively large).*

Proof: The parameter γ_2 indicates the substitutability between goods *x* and *y*. To see proposition 2, suppose γ_2 takes a small value such that $\gamma_2 < 2(1-\gamma_3^2)+\gamma_1\gamma_3$, then condition (8c) is negatively signed; and if $\gamma_2 > 2(1-\gamma_3^2)+\gamma_1\gamma_3$, then condition (8c) is positively signed.

QED

The conventional wisdom is that an appreciation of Yen makes the Chinese firm more competitive and enlarges its market share. However, proposition 2 states that if goods *x* and *y* are close substitutes (high γ_2), then Yen appreciation does *not* benefit the Chinese firm at all in terms of the volume of exports! Japanese FDI and output in China increase by so much that the Chinese firm's output is crowded out. Only if the substitutability between goods *x* and *y* is small (low γ_2), then Yen appreciation also raises the output of the Chinese firm. As documented in figure 1, these findings are supported by the Chinese data. The exports of foreign invested firms grew at a higher rate than those of Chinese firms.

As explained in section 3, goods *x* and *y* are different because the Japanese consumers differentiate them, by brand name recognition, as well as by barriers in the distribution and retail system. It follows that we can also obtain:

Corollary 1: *Under high (brand or distribution) barriers in Japan, the exports of the Chinese firm rise following Yen appreciation; and under low barriers in Japan, they may fall following Yen appreciation.*

This corollary may seem counter intuitive by casual observation. It implies that Yen appreciation alone may not necessarily hurt the Japanese firm, because it can shift production to China and conduct reverse imports. Instead, the Chinese firm's exports can be eroded by increases in Japanese FDI and reverse imports. However, Yen appreciation combined with barriers in Japan helps the Chinese firm to gain market share.

Next, let us investigate the total exports from China by combining (8a) and (8c).

$$\frac{\partial(x+y)}{\partial e} = [8-(\gamma_1 - 2\gamma_3)^2 - 4\gamma_2]w_C / \Delta < 0 . \qquad (8d)$$

And the impact on the Japanese firm's total output and market share is:

$$\frac{\partial(z+y)}{\partial e} = [2(2-\gamma_1-\gamma_2)(1-\gamma_3)+\gamma_1(\gamma_2-\gamma_1)]w_C / \Delta < 0 . \qquad (8e)$$

Condition (8d) and (8e) give rise to the following:

Proposition 3: *An appreciation in the Japanese Yen, (i) increases China's total exports to Japan; (ii) raises the total output and the market share of the Japanese firm.*

While part (i) is straightforward, part (ii) is in stark contrast to conventional wisdom. It arises under the possibility of reverse imports. Note also that in part (i), due to proposition 2, the increase in China's exports to Japan may be solely attributed to the growth of the Japanese firm's FDI and output in China, i.e., reverse imports, while the exports of the Chinese firm fall. More precisely, as part (ii) shows, the increase in *y* (reverse imports) exceeds the reduction in *z* such that the Japanese firm's total output and market share rise. While this may be contrary to conventional wisdom, as described in section 2, the empirical evidences support all of our theoretical results.

5. FDI and Reverse Imports

Whether the Japanese firm produces in China or not and how much it produces depend on a number of factors: the exchange rate, the relative wage between China and Japan,

the preferences of Japanese consumers, and the substitutability between goods *x*, *y*, and *z*. In this section, we investigate the conditions for FDI and reverse imports to arise.

Solving (6a), (6b) and (6c) together, we derive

$$y = (Aew_C - Bw_J + D)/\Delta, \tag{9}$$

$$A = (4 - 2\gamma_2 + 2\gamma_1\gamma_3 - \gamma_1^2) > 0,$$

where $B = (4\gamma_3 - \gamma_2\gamma_1) > 0,$

$$D = 2(\gamma_2 - \gamma_1\gamma_3)a + (\gamma_1^2 - 4)b + (4\gamma_3 - \gamma_2\gamma_1)c.$$

If the Japanese firm produces nothing in China at all, then $y = 0$. In other words, there are no reverse imports. Substituting $y = 0$ into equation (9) and rearranging yields

$$e = \frac{Bw_J - D}{Aw_C}. \tag{10}$$

We assume conditions for $e > 0$ are satisfied. A sufficient condition is that w_J is high. From (10) we can establish

Proposition 4: *Ceteris Paribus, (i) if* $e = (Bw_J - D)/Aw_C$, *the Japanese firm is indifferent between producing in China or Japan; (ii) If* $e > (Bw_J - D)/Aw_C$, *the Japanese firm produces only in Japan; (iii) If* $e < (Bw_J - D)/Aw_C$, *the Japanese firm also produces in China and conducts reverse imports. As the difference* $(Bw_J - D)/Aw_C - e$ *increases, the Japanese firm will raise its FDI in China.*

Proposition 4 states that if the Chinese currency is valued high, then the Japanese firm produces in Japan only; and if the Chinese currency becomes cheap, then FDI and reverse imports arise.

Similarly, we can also obtain the following from (9) if $y = 0$,

$$w_J = (Aew_C + D)/B. \qquad (11)$$

Again conditions for $w_J > 0$ are assumed automatically satisfied. Then we have:

Proposition 5: *Ceteris Paribus, (i) if* $w_J = (Aew_C + D)/B$, *the Japanese firm is indifferent between producing in China or Japan; (ii) If* $w_J < (Aew_C + D)/B$, *the Japanese firm produces only in Japan; (iii) if* $w_J > (Aew_C + D)/B$, *the Japanese firm also produces in China and conducts reverse imports. As the difference* $[w_J - (Aew_C + D)/B]$ *increases, the Japanese firm will raise its FDI in China.*

Proposition 5 says that if the Japanese wage is relatively low, then the Japanese firm produces in Japan only; and if it becomes relatively high, then FDI and reverse imports arise.

In propositions 1 and 3, we have analyzed how exchange rate changes affect Japanese FDI and reverse imports. Now, we investigate the marginal effects of changes in the wages and consumer preferences. Let $G = w_J - (Aew_C + D)/B$. Differentiation yields:

Proposition 6: *(i)* $dG/dw_J > 0$, *(ii)* $dG/dw_C < 0$, *(iii)* $dG/dc < 0$.

Proposition 6 states that an increase in the Japanese wage leads to more FDI and reverse imports; on the other hand, an increase in the Chinese wage, or an increase in the relative preference for products made in Japan, leads to less FDI and reverse imports.

6. Profits and Welfare

In this section, we look into the welfare effects of exchange rate changes.

6.1 China

The national welfare in China is simply the firm profits because consumption occurs in Japan only, which can be defined as

$$\Phi_C = \pi_C = (p_x - ew_C)x\,. \tag{12}$$

Differentiating (12), using (6a) and (3a), we derive

$$\frac{\partial \Phi_C}{\partial e} = -x(\gamma_2 \frac{\partial y}{\partial e} + \gamma_1 \frac{\partial z}{\partial e} + w_C)\,. \tag{13}$$

Substituting equations (8a) and (8b) into the above and simplifying yield

$$\frac{\partial \Phi_C}{\partial e} = \frac{4xw_C}{\Delta}[2(1-\gamma_3^2) + (\gamma_1\gamma_3 - \gamma_2)] = 2x\frac{\partial x}{\partial e}\,. \tag{13'}$$

Equation (13') measures the impact of the bilateral exchange rate movements on China's welfare. It is uncertain whether the devaluation of China Yuan (the appreciation of Japanese Yen) is welfare enhancing or not. Comparing (13') with (8c), it is immediate to see that, the necessary and sufficient condition for $\frac{\partial \Phi_C}{\partial e} < 0$, i.e., for devaluation of the Chinese Yuan to

increase Chinese welfare, is identical to the condition that devaluation boosts the Chinese firm's exports to Japan (*not* China's total exports). Alternatively speaking, China will be worse off if the devaluation of the Yuan fails to boost the exports of the domestic firm. Thus we can state:

Proposition 7: *A devaluation of the Chinese Yuan is welfare enhancing to China if and only if the devaluation could raise the Chinese firm's exports.*

6.2 Japan

The effects on the profits of the Japanese firm and national welfare in Japan are more complicated, because the Japanese firm produces in both countries and products are consumed in Japan. We first investigate the profits of the Japanese firm, using (5).

$$\frac{\partial \pi_J}{\partial e} = \frac{\partial \pi_J}{\partial x}\frac{\partial x}{\partial e} + \frac{\partial \pi_J}{\partial y}\frac{\partial y}{\partial e} + \frac{\partial \pi_J}{\partial z}\frac{\partial z}{\partial e}. \qquad (14)$$

From (6b) and (6c), we know that $\frac{\partial \pi_J}{\partial y} = \frac{\partial \pi_J}{\partial z} = 0$. Equation (14) can now be simplified to

$$\frac{\partial \pi_J}{\partial e} = -yw_C - (\gamma_1 z + \gamma_2 y)\frac{\partial x}{\partial e}. \qquad (14')$$

According to proposition 2, if goods x and y are close substitutes (high γ_2), then $\frac{\partial x}{\partial e} > 0$, which gives rise to a negative sign for (14'). It follows we can establish

Proposition 8: *An appreciation of the Japanese Yen raises the Japanese firm's total profits under reverse imports, if goods x and y are close substitutes.*

The intuition is, Yen appreciation helps the Japanese firm to acquire Chinese inputs (labor) more cheaply than the Chinese firm does. If the two products are close substitutes, then a portion of the Chinese firm's output and market share is replaced by Japanese FDI.

Next, we turn to the national welfare in Japan, which is the sum of firm profits and consumer surplus, i.e.,

$$\Phi_J = \pi_J + U(x+y+z) - xp_x - yp_y - zp_z . \tag{15}$$

Let $u(x(e), y(e), z(e)) = U(x+y+z) - xp_x - yp_y - zp_z$. Differentiating (15) to yield

$$\frac{\partial \Phi_J}{\partial e} = \frac{\partial \pi_J}{\partial e} + \frac{\partial u}{\partial x}\frac{\partial x}{\partial e} + \frac{\partial u}{\partial y}\frac{\partial y}{\partial e} + \frac{\partial u}{\partial z}\frac{\partial z}{\partial e}. \tag{16}$$

Using (3a-3c), the above becomes

$$\frac{\partial \Phi_J}{\partial e} = (p_z - w_J)\frac{\partial z}{\partial e} + (p_y - ew_C)\frac{\partial y}{\partial e} - w_C y - x\frac{\partial p_x}{\partial e}, \tag{16'}$$

where $\frac{\partial p_x}{\partial e} = -(\frac{\partial x}{\partial e} + \gamma_2 \frac{\partial y}{\partial e} + \gamma_1 \frac{\partial z}{\partial e}) > 0$, obtained by differentiating (3a) and using (8a-8c).

And $\frac{\partial y}{\partial e} < 0$ and $\frac{\partial z}{\partial e} > 0$ are given in (8a) and (8b).

Equation (16') indicates that the change of Japanese welfare due to an appreciation of the Japanese Yen (i.e., a decrease in *e*) consists of four parts: the first is the profit reduction of the Japanese firm due to its reduced output in Japan, i.e., the decrease in *z*; the second is

the increased profit generated from the production expansion of the Japanese firm in China, i.e., the increase in y; the third is a decrease of production cost in China due to less expensive Chinese labor measured in Yen; and the last part is an increase in Japanese consumer surplus induced by a decrease in the price of good *x*. The first component contributes to Japanese welfare negatively while the second, third and the last terms contribute positively. In general the sign of (16') is ambiguous.

Given that $(p_z - w_J)$ and $(p_y - ew_C)$ measure the profit margins of goods *z* and *y* respectively, as long as the latter dominates the former, i.e., the profit margin of the Japanese production being higher in China than in Japan, an appreciation of the Japanese Yen improves Japan's welfare.

Proposition 9: *Under reverse imports, an appreciation of the Japanese Yen is welfare enhancing for Japan, if the Japanese firm's profit margin is higher in China than in Japan.*

Proof: From (8a), (8b) and (8e), we must have

$$0 < \frac{\partial z}{\partial e} < -\frac{\partial y}{\partial e}. \qquad (17a)$$

If the profit margin of the Japanese firm is higher in China than in Japan, then,

$$0 < (p_z - w_J) < (p_y - ew_C). \qquad (17b)$$

Multiplying (17a) and (17b) and rearranging lead to

$$\frac{\partial z}{\partial e}(p_z - w_J) + \frac{\partial y}{\partial e}(p_y - ew_C) < 0. \qquad (18)$$

Since $\frac{\partial p_x}{\partial e} > 0$, using (18), the sign of equation (16') can be determined as

$$\frac{\partial \Phi_J}{\partial e} < 0. \qquad (16")$$

It states that Japan's welfare increases if the Yen appreciates under reverse imports.

QED

Proposition 9 implies that as Yen appreciation drives Japanese production facilities overseas, FDI improves profits as long as the profit margins are higher overseas. And under reverse imports, products are imported back to Japan for consumption, resulting in no loss of consumer surplus. The total effect is an increase in national welfare.

7. Concluding Remarks

There is voluminous literature on the trade-FDI nexus and the FDI-exchange rate nexus. However, theoretical studies on systematic linkages among exports, FDI and exchange rates are scant. The present paper basically fills the gap in the existing literature. We modeled the systematic linkage among reverse imports, FDI, and exchange rates, using a structure in which a Japanese MNE producing in both Japan and China and engaging in reverse imports from its Chinese affiliate, and a Chinese firm competing with the Japanese firm. We investigated the conditions for reverse imports to arise, and found that exchange rate changes, wage differentials, and barriers in brand name as well as retail systems contribute to increases in Japanese outward FDI and reverse imports. The model showed that due to the barriers in brand name and the distribution system, it is uncertain whether the exports of the Chinese firm rise or not when the Chinese Yuan depreciates against the Japanese Yen. It is

highly likely that the growth of reverse imports erodes the market share of Chinese firm. In other words, the Chinese firm could be a loser of Yen appreciation due to the strong competition of reverse imports by Japanese MNEs. The predictions of the model fit well with the actual data. And depending on product differentiability, Yen appreciation may improve profits of the Japanese firm and welfare in Japan under reverse imports.

We have assumed that firms compete in quantity with differentiated products. They could also compete in prices. It is well known that prices are lower and outputs higher under price competition than under quantity competition (see for instance, Cheng, 1985). Other than these, all of our qualitative results remain valid.

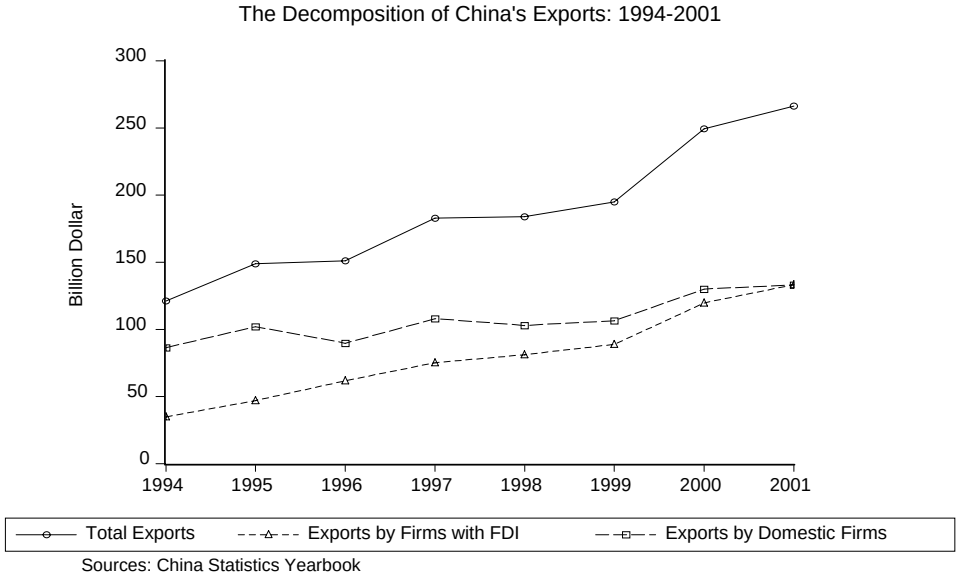
To simplify the analysis, sales in China were assumed to be zero. If we allow positive sales in China, as long as there is market segmentation, our analysis on reverse imports, FDI and the exchange rate remains robust.

Goods *y* and *z* are treated as differentiated products, though they are made by the same firm. It is necessary to note that our results mainly depend on the substitutability between goods *x* and *y*. Even if goods *y* and *z* are treated as perfect substitutes, as long as the substitutability between goods *x* and *y* satisfies the specified conditions in the model, then our results carry through.

Adding fixed costs for FDI or transportation for imports changes the level of profits and welfare, but not the qualitative results of the model.

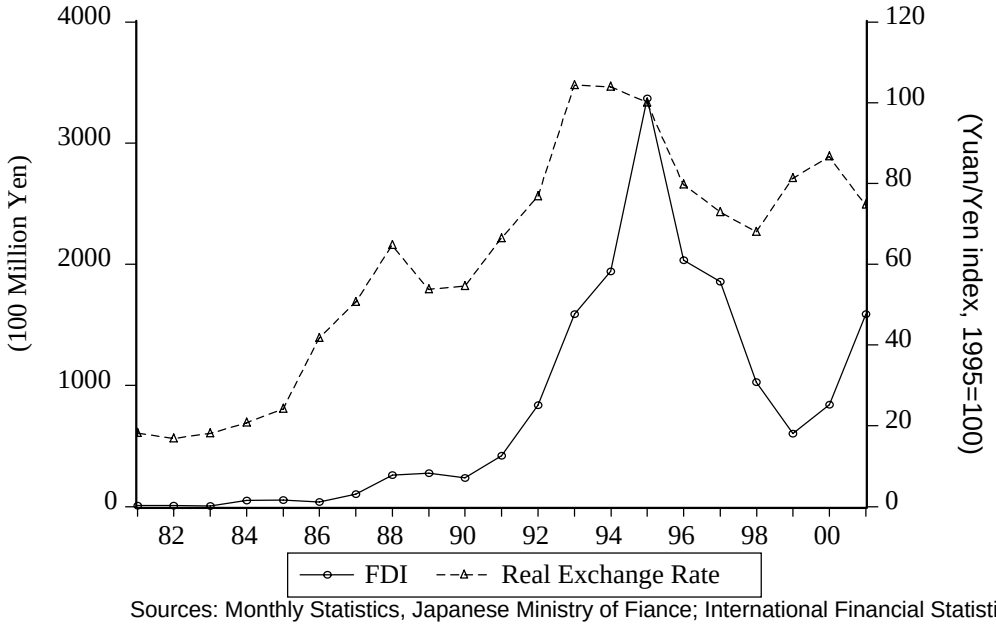
Finally, production in the present model consists of one stage only. The analysis becomes more complicated in a structure with both intermediate and final productions. This remains a fruitful avenue for future research.

Figure 1



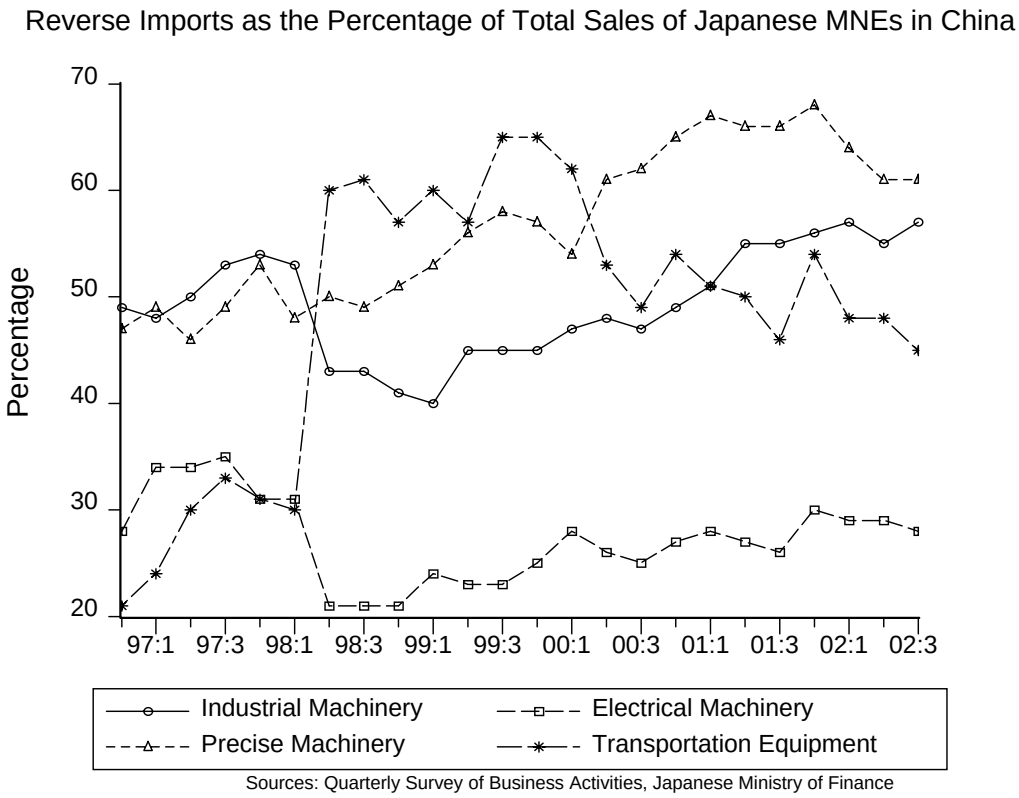
Sources: China Statistics Yearbook

Figure 2



Sources: Monthly Statistics, Japanese Ministry of Fiance; International Financial Statistics, IMF.

Figure 3


Reverse Imports as the Percentage of Total Sales of Japanese MNEs in China
Percentage
70
60
50
40
30
20
97:1
97:3
98:1
98:3
99:1
99:3
00:1
00:3
01:1
01:3
02:1
02:3
Industrial Machinery
Electrical Machinery
Precise Machinery
Transportation Equipment
Sources: Quarterly Survey of Business Activities, Japanese Ministry of Finance

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