

Reverse Imports, Foreign Direct Investment and Exchange Rates

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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. The model shows that yen appreciation 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, 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. Further, we find that yen appreciation may improve the profits of the Japanese firm and welfare in Japan under reverse imports, against conventional wisdom. The predictions of the model fit well with the actual figures, and shed light on the current, heated China debate.

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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. 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, labor in China was even cheaper ten years ago compared with that of today. Why was "Made in China" not popular then?

Further, 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 heated, current debate on China,¹ 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 was even stronger a decade ago.

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

¹ For example, as the US presidential election campaign began, politicians and pressure groups are drawing the candidates' attention, by alleging that the Chinese currency has made lots of American workers jobless. Japanese Finance Minister Masajuro Shiokawa repeatedly accused China of "exporting deflation" to Japan.

Japanese market. The Japanese firm can also produce in China. Products are differentiated due to brand name recognition. We find that exchange rate changes, wage differentials, and barriers in brand name 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, 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. This implies that outsourcing has made the Chinese economy and those of foreign MNEs’ home countries interdependent.

The model sheds light on the current China debate, because the predictions of the model fit well with the actual figures of China. The sudden popularity of “Made in China” can be ascribed to China’s devaluation at early 1990s, in addition to other factors. The devaluation of the 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. In other words, it is the influx of export-oriented FDI, which contributed to China’s export boom.

It is also counter intuitive that the Chinese yuan’s depreciation against the Japanese yen may not raise the exports of Chinese domestic firms. Even worse, Chinese domestic

firms may lose their market shares. 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. Relatively low cost of reverse imports together with high consumer recognition enhance the competitiveness of MNEs in Japanese domestic market. If there exists a high substitutability between the products of Chinese firms and the products made by Japanese affiliates in China, then these increased reverse imports will replace outputs made by the Chinese firm. On the other hand, 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.

There are numerous studies on China's FDI boom, for instance, Branstetter and Feenstra (1999) show that FDI inflows reflect political openness and state ownership in China; Cheng and Kwan (2000) find that large regional market, good infrastructure, and preferential policy are important determinants of FDI in China; Feenstra and Hanson (2003) examine the organization of export processing operations of foreign MNEs in China and test the property rights model. Lardy (1995), Henly et al (1999) and Zhang (2001) identify potential market size, low labor cost, preferential policies (e.g., tax credits), openness, geographic proximity, and political stability as primary factors attracting FDI inflows to China. However, the role of exchange rate fluctuations has been neglected.

In a recent paper, Greaney (2003) also studies reverse imports based on US-Japan trade, but focusing on the impact of business and social networks on international trade and FDI, as suggested in Rauch (1999), and Qiu and Spencer (2002). She shows the possibility

that the firm from the country with stronger network effects (the home country) invests abroad while the foreign firm does not. Baldwin and Ottaviano (2001) generate reverse imports, by applying the Brander-Krugman reciprocal dumping idea in a model with trade costs and differentiated products. In addition, Yeaple (2002), Ekholm, Forslid and Markusen (2003) analyze the MNE's location choices in three-country models, but focusing on trade and transportation costs and production technology. In the present paper, we focus on the effects of exchange rate movements, based on the Sino-Japanese trade and FDI.

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

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). 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. The exports of domestic firms averaged about 6.4 percent annually. In contrast, the exports of foreign invested firms showed much higher and more consistent growth during the period at 21.2 percent annually. The empirical evidences indicate that the exceptional growth of China's exports largely relies on the robust growth of foreign invested firms. <<Figure 1>>

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 1995, 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. <<Figure 2>>

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

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 1996 to 61 percent in 2002; for transportation equipment, it rose from 19 percent in 1996 to more than 45 percent; for industrial machinery, it rose to 57 percent from 49 percent during the same period. <<Figure 3>>

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.

The goods made by the Japanese firm in China and sold under Japanese brand names enjoy much better 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:

$$V(m, x, y, z) = m + U(x, y, z) , \quad (1)$$

where

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

In (2), we assume that $a, b, c > 0$ 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 standard budget constraint yields the inverse demand functions for goods x , y , and z in units of good m .

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

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

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

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 both capital and labor are used as inputs.² For simplicity, we normalize such that all firms have identical technology: one unit of output requires one unit of *each* input. 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 total cost of hiring one unit of capital *and* one unit of labor in China and Japan be w_i , $i = C, J$. Then the profit function of the Chinese firm can be written as

$$\pi_C = (p_x - ew_C)x, \quad (4)$$

where e denotes the exchange rate, i.e., the price of the yuan in terms of the yen. The exchange rate enters because the firm's cost is paid in the Chinese currency.

² Also see the literature on the new FDI theory (e.g., Markusen, 1984; Helpman, 1985; Ethier, 1986; Levinsohn, 1989; Blonigen and Ono, 1998; Glass and Saggi, 1999), in which FDI does not need to involve physical capital movement abroad. In fact, this has become standard textbook material (see for instance Feenstra, 2002, p.11-3, p.11-46).

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

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

where F is a fixed cost for FDI. In contrast, fixed cost is not incurred when producing at home. In addition, transportation cost is assumed to be zero.³ For analysis stressing fixed costs and transportation costs of FDI, see Dei (1990), Markusen and Venables (1998), McLaren (2000), Yeaple (2002) and Ekholm, Forslid and Markusen (2003).

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:

$$a - 2x - (\gamma_2 y + \gamma_1 z) - ew_C = 0. \quad (6a)$$

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

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

$$c - 2z - (\gamma_1 x + 2\gamma_3 y) - w_J = 0. \quad (6c)$$

³ Incorporating transportation cost for imports changes the level of profits and welfare, but not the qualitative results of the model.

We assume all necessary conditions for an interior solution are satisfied. 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

4.2. Comparative Statics Analysis

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

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

The determinant of the Hessian matrix is $\Delta = 2(\gamma_1^2 + \gamma_2^2 + 4\gamma_3^2) - 4\gamma_1\gamma_2\gamma_3 - 8 < 0$, given the assumption $0 < \gamma_1 < \gamma_2 < \gamma_3 < 1$. From (7), some interesting comparative statics results can be derived.

$$\frac{dy}{de} = [2\gamma_1\gamma_3 + 4 - (\gamma_1^2 + 2\gamma_2)]w_C / \Delta < 0, \quad (8a)$$

$$\frac{dz}{de} = [(2\gamma_2\gamma_3 - 4\gamma_3) + (\gamma_1\gamma_2 - 2\gamma_1)]w_C / \Delta > 0, \quad (8b)$$

$$\frac{dx}{de} = 2[2(1 - \gamma_3^2) + (\gamma_1\gamma_3 - \gamma_2)]w_C / \Delta. \quad (8c)$$

⁴ Closed form solutions of the endogenous variables can be obtained, but in messy algebraic forms.

Conditions (8a) and (8b) state that an appreciation of the yen leads to an increase in Japanese FDI and reverse imports, and a decrease of output in Japan. These may seem obvious by casual observation. The importance is, currency appreciation affects FDI flows, which the classical literature says otherwise. In the present model, this effect arises from the existence of “reverse imports”, i.e., the increased Japanese FDI (output) in China, which is eventually exported to Japan for consumption. Our results complement the recent literature such as Klein (1994), Goldberg and Klein (1997), and Blonigen (1997), who obtain a similar result but not based on reverse imports.

Through FDI, the Japanese firm can take advantage of yen appreciation by buying Chinese inputs more cheaply, enabling it to gain an edge over the Chinese firm (which buys Chinese inputs with the Chinese currency). In the absence of reverse, products are sold in China and profits are repatriated back to Japan. Then yen appreciation does not benefit the Japanese firm after profits are repatriated in yen, and hence exchange rate movements do not affect FDI flows.

Condition (8c) implies the following:

Proposition 1: *An appreciation of the yen leads to a decrease in the exports of the Chinese firm if γ_2 is sufficiently large.*

Proof: The parameter γ_2 indicates the substitutability between goods x and y . To see proposition 1, 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.

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The conventional wisdom is that an appreciation of the yen makes the Chinese firm more competitive and enlarges its market share. However, proposition 1 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 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 much 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. It follows that we can also obtain:

Corollary 1: *Under high brand name barriers in Japan, the exports of the Chinese firm rise following yen appreciation; and under low barriers in Japan, they 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).

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

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

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

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

Proposition 2: *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 1, 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 and capital costs 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

$$y = (Aew_C - Bw_J + D) / \Delta, \quad (9)$$

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

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

$$e = \frac{Bw_J - D}{Aw_C}. \quad (10)$$

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

Proposition 3: *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 3 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. A similar result on the comparison of wages and capital rental can be obtained. That is, if the Japanese wage and capital costs are relatively low, then the Japanese firm produces in Japan only; and if they become relatively high, then FDI and reverse imports arise.

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

$$dG / dw_J > 0 , \quad (11a)$$

$$dG / dw_C < 0 , \quad (11b)$$

$$dG / dc < 0 . \quad (11c)$$

That is, an increase in the Japanese wage and capital costs leads to more FDI and reverse imports; on the other hand, an increase in the Chinese wage and capital costs, 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

$$\Phi_C = \pi_C = (p_x - ew_C)x. \quad (12)$$

Differentiating (12) with respect to e and using (6a) and (3a), we derive

$$\frac{d\Phi_C}{de} = -x(\gamma_2 \frac{dy}{de} + \gamma_1 \frac{dz}{de} + w_C). \quad (13)$$

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

$$\frac{d\Phi_C}{de} = \frac{4xw_C}{\Delta} [2(1 - \gamma_3^2) + (\gamma_1\gamma_3 - \gamma_2)] = 2x \frac{dx}{de}. \quad (13')$$

Equation (13') measures the impact of the bilateral exchange rate movements on China's welfare. It is uncertain whether the devaluation of the Chinese yuan (appreciation of the Japanese yen) is welfare enhancing or not. Comparing (13') with (8c), it is immediate to see that, the necessary and sufficient condition for $\frac{d\Phi_C}{de} < 0$, i.e., for devaluation of the 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 devaluation of the yuan fails to boost the exports of its domestic firm. Thus we can state:

Proposition 4: *A devaluation of the 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. Differentiating the profit function of the Japanese firm with respect to e yields

$$\frac{d\pi_J}{de} = \frac{\partial\pi_J}{\partial x} \frac{dx}{de} + \frac{\partial\pi_J}{\partial y} \frac{dy}{de} + \frac{\partial\pi_J}{\partial z} \frac{dz}{de} + \frac{\partial\pi_J}{\partial e}. \quad (14)$$

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

$$\frac{d\pi_J}{de} = -yw_c - (\gamma_1 z + \gamma_2 y) \frac{dx}{de}. \quad (14')$$

According to proposition 1, if goods x and y are close substitutes (high γ_2), then

$\frac{dx}{de} > 0$, which gives rise to a negative sign for (14').

Proposition 5: *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 that, yen appreciation helps the Japanese firm to acquire Chinese inputs 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 reverse imports.

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

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

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

$$\frac{d\Phi_J}{de} = \frac{d\pi_J}{de} + \frac{\partial u}{\partial x} \frac{dx}{de} + \frac{\partial u}{\partial y} \frac{dy}{de} + \frac{\partial u}{\partial z} \frac{dz}{de} + \frac{\partial u}{\partial e}. \quad (16)$$

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

$$\frac{d\Phi_J}{de} = (p_z - w_J) \frac{dz}{de} + (p_y - ew_C) \frac{dy}{de} - w_C y - x \frac{dp_x}{de}, \quad (16')$$

where $\frac{dp_x}{de} = -(\frac{dx}{de} + \gamma_2 \frac{dy}{de} + \gamma_1 \frac{dz}{de}) > 0$, obtained by differentiating (3a) and using (8a-8c).

And $\frac{dy}{de} < 0$ and $\frac{dz}{de} > 0$ are given in (8a) and (8b).

Equation (16') indicates that the change of Japanese welfare due to an appreciation of the 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 and capital 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 yen improves Japan's welfare.

Proposition 6: *Under reverse imports, an appreciation of the 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

$$0 < \frac{dz}{de} < -\frac{dy}{de}. \quad (17a)$$

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

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

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

$$\frac{dz}{de}(p_z - w_J) + \frac{dy}{de}(p_y - ew_C) < 0. \quad (18)$$

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

$$\frac{d\Phi_J}{de} < 0. \quad (16'')$$

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

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Proposition 6 implies that as yen appreciation drives Japanese production facilities overseas, FDI improves the total profits of Japanese firms as long as the profit margins are higher overseas. Under reverse imports, products are imported back to the Japanese domestic market, enhancing Japanese consumers' surplus. Therefore, the total effect of the yen's appreciation is an increase in the 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, 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 and capital cost differentials, and barriers in brand name recognition contribute to increases in Japanese outward FDI and reverse imports.

The model could shed light on the current China debate. 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. The model showed that due to the barriers in brand name recognition, it is uncertain whether the exports of the Chinese firm rise or not when the yuan depreciates against the yen. It is highly likely that the growth of reverse imports erodes the market share of Chinese firm. In other words, Chinese firms 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. Depending on product differentiability, yen appreciation may improve profits of the Japanese firm and welfare in Japan under reverse imports.

One might argue that even though Japanese welfare increases under reverse imports, Japanese employment may fall because the MNE shifts production to China. It is worth noting that even if unemployment assistance is incorporated in the paper, the mechanism generating our results does not disappear. That is, exchange rate movements affect FDI and reverse imports, through which Japan may gain in welfare. But the gain may be smaller taking consideration of unemployment assistance and training.

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.

We have investigated the impact of exchange rate changes. The mechanism is the same if wages or other production costs increase in China. Further, commercial policy such as tariffs can be incorporated in the model. Increases in import tariffs cause identical effects as currency depreciation in Japan.

The present framework can also be extended to three countries. In Zhao and Xing (2003), we analyze the case of a northern MNE shifting production among two southern countries and a northern country.

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

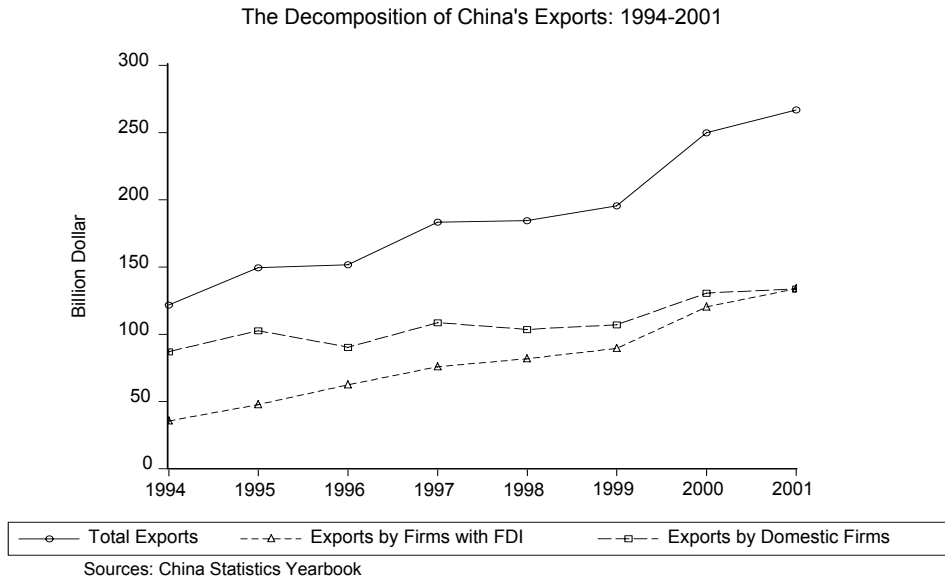


Figure 2

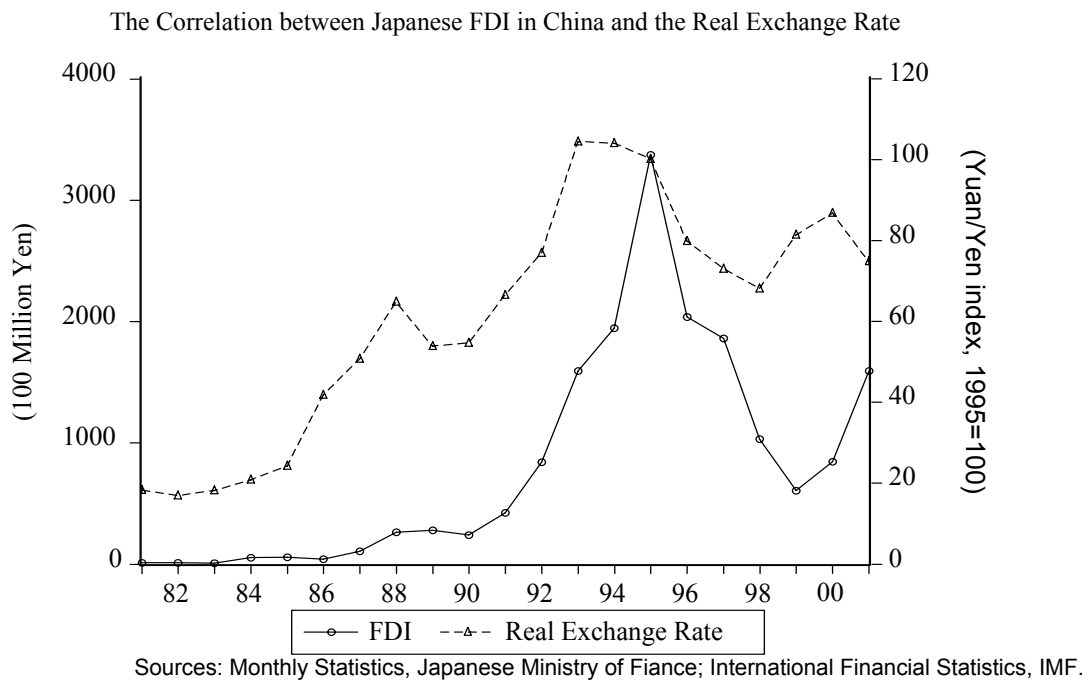
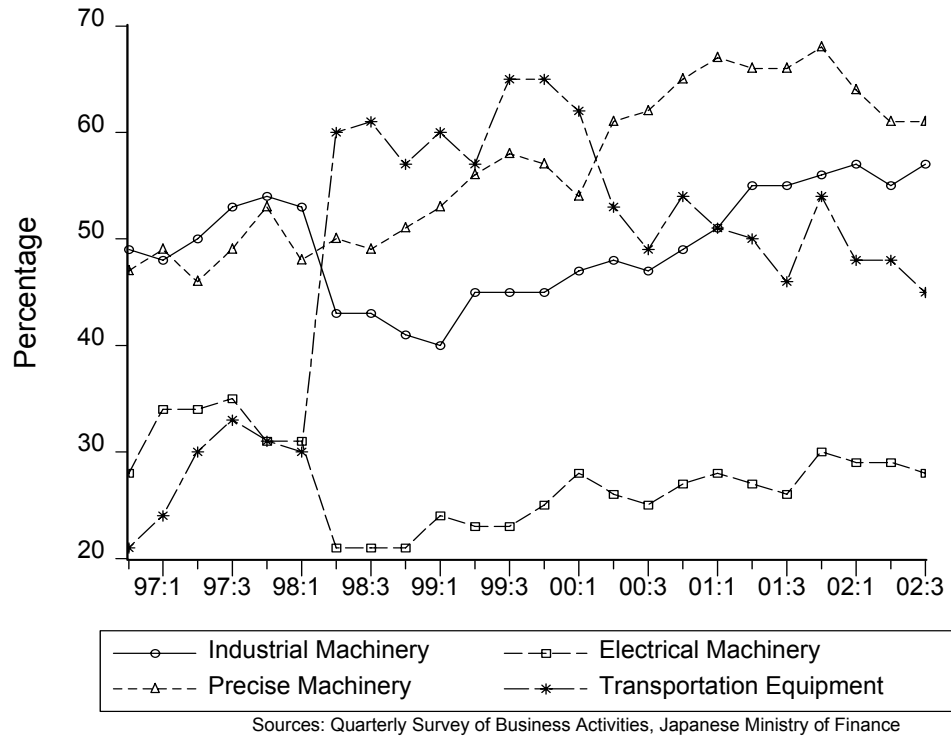


Figure 3

Reverse Imports as the Percentage of Total Sales of Japanese MNEs in China



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