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Abstract

We model the production allocation choices of a multinational enterprise (MNE) in a three-country framework -- one northern country and two southern ones. Products made in the South are of lower quality than those made in the North. Substitutability between goods differs due to variations in product quality. We investigate how exchange rates affect production, employment and welfare, and find that currency devaluation from different countries brings contrasting results. In particular, an appreciation in the southern country (X) producing the lowest-quality good with the least cost may reduce production (employment) in the North, while an appreciation in the other southern currency (Y) always does the opposite. A northern depreciation against both southern currencies may increase production in country X, but always reduces that in country Y. These arise because the MNE shifts production globally to minimize costs. Northern welfare always falls following currency appreciation in southern countries.

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1. Introduction

It has been argued that the devaluation of the Chinese currency "yuan" since the late 1980s played a significant role in fostering China's two-digit export growth in the last two decades. However, the indirect impact of yuan devaluation, which has been realized through the influx of export oriented foreign direct investment (FDI), has been far more important in increasing exports, than the direct effect on the exports of Chinese domestic firms. For instance, from 1992 to 2001, China's exports more than tripled from $US84.94 billion to $US266.15 billion (China Statistics Yearbook, various years). But such dramatic increase was mainly the contribution of foreign multinationals. Over the same period, exports of foreign invested firms increased by more than 75 times, from $US1.74 billion to $US 133.24 billion. In 2001, the exports of such firms exceeded 50 percent of China's total exports. Even though the Chinese currency devalued substantially in the early 1990s, it seems that Chinese domestic firms surprisingly failed to benefit from it.

In fact, multinationals' global outsourcing activities have made major economies dependent on China as a source of cheap labor. Due to the contributions of foreign MNEs, China became the largest destination country of FDI in the world, overtaking the US in 2003. Multinationals flock to China for its cheap labor, land and other inputs (a phenomenon Krugman (1998) calls "fire-sale FDI"), to conduct export-processing operations. Feenstra and Hanson (2003) report that over the years 1997-1999 processing exports accounted for 53.7% of China's total exports. The reality check reveals that, (1). China's rapid exports growth is mainly driven by export-oriented FDI, especially as a result of global outsourcing activities of foreign MNEs; (2). The yuan's devaluation strengthened China's competitiveness in attracting global FDI and redirecting outsourcing activities to China.[1]

The phenomenon above motivates us to analyze the role of exchange rates in global outsourcing and its implications on commercial policy. We consider an MNE with production

facilities in three different countries -- a northern country (Z) and two southern countries (X and Y). The products made in the southern countries are of lower quality and incur lower costs than the one made in the North. Substitutability between any two of the three goods varies due to differences in quality and production location. We examine the effects of exchange rate changes on production (employment), profits and welfare, and find that currency devaluation from different countries gives rise to contrasting and unconventional results.

Specifically, a currency appreciation in the southern country X producing the lowest-quality good with the least cost may reduce production (employment) in the North, while an appreciation in the other southern currency (Y) always raises production in the North. A northern depreciation against both southern currencies may increase production in country X, but always reduces that in country Y. These arise because the MNE shifts production to minimize costs. Under such global outsourcing, northern welfare always falls following currency appreciation in southern countries.

Despite its simplicity, the model sheds light on the current China debate. China's role in manufacturing is still only a provider of cheap labor, with "an unlimited supply". And the majority of Chinese exports are low-price, low quality goods such as textiles, shoes, toys, plastic products, electronic appliances, etc, which are usually sold at deep discount stores such as Wal-Mart. Limited appreciation of the yuan simply reduces China's comparative advantage relative to other developing countries, and redirects export-oriented FDI to these areas. As a consequence, products from these countries may replace those "Made in China" in the global market. Industrialized countries, on the other hand, may not benefit from the yuan's appreciation. Cries of "hollowing out" and "de-industrialization" will continue, except for the destination.[2]

While the classical literature believes exchange rate movements do not affect FDI flows, recent theoretical works find a close relationship between exchange rates and FDI, see for instance, Cushman (1985, 1988), and Froot and Stein (1991). Several empirical studies, such as Klein and

Rosengren (1994) and Goldberg and Klein (1997), find support for the theoretical analysis. 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. Recently, Greaney (2003) generate reverse imports in a model of trade and FDI networks. Chen, Ishikawa and Yu (2002) study strategic outsourcing activities that are not related to exchange rates. Regarding FDI in China, Branstetter and Feenstra (1999) show that FDI inflows reflect political openness and state ownership there; Cheng and Kwan (2000) find that large regional market, good infrastructure, and preferential policy are important determinants of FDI; Feenstra and Hanson (2003) examine the organization of export processing operations of foreign MNEs in China and test the property rights model.

2. Basic Model Setup

Consider two southern countries X, Y, and a northern country Z. We focus on the northern market, say either the US, Europe or Japan. A typical northern consumer consumes a numeraire good *m*, and three differentiated goods: *x*, *y,* and *z*, all produced by a single MNE whose home country is Z. Goods *x*, y, and *z* are produced respectively in countries X, Y and Z, i.e., goods *x* and *y* are the products of FDI by the MNE from country Z in respectively countries X and Y which do not own any firm. All goods are sold in country Z only, and hence its total imports are $x + y$. The products made in the North have the highest recognition in quality. In contrast, the goods made in the southern countries have low acceptance by northern consumers, since they are usually considered as low quality goods. In addition, the recognition in quality is lower for good *x* than for good *y*.

Given the above, the typical northern consumer can be assumed to maximize the following quasi-linear utility function, following Dixit (1979):

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

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

The parameter γ_{ij} indicates the substitutability between goods *i* and *j*, for all $i, j = x, y, z, \ \ i \neq j$. We assume $0 < a < b < c$, and that

$$0<\gamma_{xz}<\gamma_{xy}<1, \quad \text{and} \quad 0<\gamma_{xz}<\gamma_{yz}<1, \qquad (2)$$

which hopefully capture the preferences of the northern consumers roughly. They imply: (i) the three goods x, y, z are imperfect substitutes; (ii) the lowest quality good *x* and the highest quality good *z* are most differentiated, and the substitutability between these two is always lower than that between any other pair of goods. In addition, if $\gamma_{ij} = 0$, there is zero substitutability; and if $\gamma_{ij} = 1$, there is perfect substitutability. We exclude these two special cases in the present model.

We wish to use this setup to illustrate the scenario of a northern MNE outsourcing in two developing countries, say China (country X) and ASEAN (country Y) as examples. The northern made good has the highest quality, the ASEAN made one has the middle quality, and the Chinese made one has the lowest quality. However, the quality difference between the ASEAN made and the Chinese made is very small.

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*.

$$p_x = a - x - (\gamma_{xy}y + \gamma_{xz}z), \qquad (3a)$$

$$p_y = b - y - (\gamma_{xy}x + \gamma_{yz}z), \qquad (3b)$$

$$p_z = c - z - (\gamma_{xz}x + \gamma_{yz}y). \qquad (3c)$$

On the production side, we assume the MNE uses identical technology in all countries. Let the constant marginal cost of production in each country be w_i, $i = \text{X,Y,Z}$. The profit function of the MNE consists of three parts: the sum of those from each country.

$$\pi = (p_z - w_Z)z + (p_x - \alpha e_X w_X)x + (p_y - \alpha e_Y w_Y)y - 2F \,. \qquad (4)$$

The parameter e_j, $j = \text{X,Y}$, denotes the exchange rate, i.e., the price of country *j*'s currency in terms of country Z's currency. The exchange rate enters because the MNE's cost is paid in country *j*'s currency when undertaking FDI there, while profits are accrued in country Z's currency. We assume $e_X w_X \le e_Y w_Y < w_Z$, i.e., the ranking of average cost follows that of product quality introduced earlier. This assumption can be justified on the grounds that (i). wages are different across countries, (ii). the MNE allocates production of goods of different quality to different destinations according to cost rankings. We also assume that the exchange rate does not affect the demand of the goods directly, but indirectly through price adjustments following changes in the production costs. The parameter $\alpha > 0$ will be used to conduct analysis on northern currency policy against both southern countries simultaneously, in contrast to northern policy against only one southern currency, which is represented by changes in e_j. Finally, *F* is a fixed cost for each FDI plant.[3] The fixed cost is not incurred when producing at home. In addition, transportation cost is assumed to be zero. For analysis stressing fixed and transportation costs of FDI, see Dei (1990), Markusen and Venables (1998), McLaren (2000) and Ekholm, Forslid and Markusen (2003).

3. The Equilibrium and Its Properties

The MNE chooses *x*, *y*, and *z* to maximize (4). Using (3a)~(3c), the FOCs are

$$a - 2x - 2(\gamma_{xy} y + \gamma_{xz} z) - \alpha e_X w_X = 0, \tag{5a}$$

$$b - 2y - 2(\gamma_{xy} x + \gamma_{yz} z) - \alpha e_Y w_Y = 0, \tag{5b}$$

$$c - 2z - 2(\gamma_{xz} x + \gamma_{yz} y) - w_Z = 0. \tag{5c}$$

Given the exchange rates, marginal costs, and substitutability parameters, conditions (5a)~(5c) jointly determine a unique solution (x, y, z), which is the optimal production allocation over the three countries. Closed form solutions can be obtained, but in messy algebraic forms and hence are omitted here. Total differentiation of these conditions yields the following matrix.

$$-2\begin{pmatrix} 1 & \gamma_{xy} & \gamma_{xz} \\ \gamma_{xy} & 1 & \gamma_{yz} \\ \gamma_{xz} & \gamma_{yz} & 1 \end{pmatrix}\begin{pmatrix} dx \\ dy \\ dz \end{pmatrix} = \alpha w_X \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} de_X + \alpha w_Y \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} de_Y + \begin{pmatrix} w_X e_X \\ w_Y e_Y \\ 0 \end{pmatrix} d\alpha \tag{6}$$

Invoking assumption (2), the determinant of the Hessian matrix is found to be,

$$\Delta = 2(\gamma_{xy}^2 + \gamma_{yz}^2 + \gamma_{xz}^2 - 1 - 2\gamma_{xy}\gamma_{yz}\gamma_{xz}) < 0. \tag{7}$$

Now, we investigate how changes of the exchange rates affect the production allocation decisions of the MNE in the three countries. If the currency of country X appreciates against that of country Z, e_X will rise. From (6), we derive

$$dx / de_X = 4\alpha w_X (1 - \gamma_{yz}^2) / \Delta < 0, \tag{8a}$$

$$dy/de_X = -4\alpha w_X(\gamma_{xy} - \gamma_{xz}\gamma_{yz})/\Delta > 0\,, \tag{8b}$$

$$dz/de_X = 4\alpha w_X(\gamma_{xy}\gamma_{yz} - \gamma_{xz})/\Delta\,. \tag{8c}$$

Conditions (8a) and (8b) indicate that, a currency appreciation in country X reduces production there, but raises that in country Y, because the cost of production in country X increases, causing the MNE to shift production away to country Y.

The sign of (8c) is ambiguous. Normally, one would expect it to be positive, i.e., an appreciation in country X to raise production in country Z, due to production substitution. Careful examination of (8c) reveals that it is negatively signed if $\gamma_{xy} > \gamma_{xz}/\gamma_{yz}$. This implies that, if the substitutability between goods *x* and *y* is high and that between *x* and *z* is not as high as that between *y* and *z*, the northern output will decrease rather than increase. In other words, currency appreciation in country X raises the new equilibrium price p_x, resulting in substitution for both goods *y* and *z*. Simultaneously, to avoid the rising cost in country X, the MNE shifts production to country Y. And if consumers can easily substitute good *y* for good *x*, then the MNE will shift production by so much that production in its home country Z is also substituted out.

If $\gamma_{xy} = \gamma_{xz}/\gamma_{yz}$, then the signs of (8a) and (8b) remain unchanged, while (8c) becomes $dz/de_X = 0$, suggesting that the output in the north will not increase. In other words, revaluation in the currency of the country producing the lowest-quality good will not revert outsourcing activities back to the northern country.

If $\gamma_{xy} < \gamma_{xz}/\gamma_{yz}$, then $dz/de_X > 0$ in (8c), implying that the output in the north will increase as the currency in country X appreciates. This scenario requires two conditions: (i) goods *x* and *y* have almost equal substitutability with good *z*, and (ii) the substitutability between goods *x* and *y*

themselves is low. In addition, in our example of China producing the lowest quality good *x* and ASEAN producing the middle-quality good *y*, condition (8c) becomes positively signed if after some years of development, China catches up in technology so that the quality of good *x* becomes equal or better than good *y*. In such a case, $\gamma_{xz}/\gamma_{yz} \geq 1 > \gamma_{xy}$ arises.

In summary, as long as there exist multiple destination countries for outsourcing activities, it is not certain that currency appreciation in the country producing the lowest quality will force the northern MNE to move back production to its home country. Relocating production to another outsourcing destination country is the first choice to avoid the rising costs induced by the appreciation. The above can be restated in the following proposition.

Proposition 1: *Under outsourcing FDI in two southern countries, a currency appreciation in the southern country producing the lowest quality product against the northern currency, (i). raises production in the other southern country; (ii). reduces (raises) production in the northern country if the substitutability between the products made in the two southern countries is high (low) enough.*

Analogously, an appreciation of country Y's currency leads to:

$$dx/de_Y = -4\alpha w_y(\gamma_{xy} - \gamma_{yz}\gamma_{xz})/\Delta > 0, \quad (9a)$$

$$dy/de_Y = 4\alpha w_Y(1-\gamma_{xz}^2)/\Delta < 0, \quad (9b)$$

$$dz/de_Y = 4\alpha w_Y(\gamma_{xy}\gamma_{xz} - \gamma_{yz})/\Delta > 0. \quad (9c)$$

The interpretations of (9a) and (9b) are similar to (8a) and (8b). The important difference arises between conditions (8c) and (9c). While the former can be positive, zero, or negative, the latter is always positively signed, i.e.,

Proposition 2: *An appreciation in the country producing the middle-quality good always raises production in the country producing the highest-quality good.*

Proof: It suffices to prove the sign of (9c). Because $\Delta < 0$, we need $\gamma_{xy}\gamma_{xz} - \gamma_{yz} < 0$, i.e., $\gamma_{xy} < \gamma_{yz} / \gamma_{xz}$. But the assumptions $0<\gamma_{xy}<1$ and $0<\gamma_{xz}<\gamma_{yz}<1$ guarantee that $\gamma_{xy} < 1 < \gamma_{yz} / \gamma_{xz}$ always holds. QED

Note that currency appreciation in the present model brings two effects: one on production cost, the other on demand (through price changes). Regarding the former, the MNE always chooses the optimal level of output in each country (i.e., shifting production among the three countries) to maximize total global profits. The interpretation for proposition 2 lies in the demand side, which can be summarized as follows.

Assumption (2) implies that the qualities and consumer preference for the three goods can be ranked as $x \prec y \prec z$. That is, good *y* lies in the middle. Similar to the previous case, p_y increases following currency appreciation in country Y. The subsequent adjustment of optimal consumption leads to substitution for both goods *x* and *z*. The critical difference here lies in that *y* is the middle good. The closer substitutability between *y* and *z* (than between *x* and *z*) as well as the improved quality from *y* to *z* guarantees that the substitution effect is positive for good *z*. Thus, the MNE increases production of both *x* and *z*.

In contrast, as Proposition 1 shows, if appreciation occurs in country X, because good *x* is the lowest quality good and has higher substitutability with *y* than *z*, the representative consumer substitutes most of the reduced consumption on *x* by *y*, resulting in relatively small substitution effects for *z*. Coupled with the rising production cost due to the appreciation in country X, the MNE thus cuts its production in country Z.

Next, we investigate the case that country Z devalues its currency against both southern currencies, which can also be viewed as a coordinated appreciation of the latter currencies, i.e., an increase in parameter α. From equation (6), we derive

$$dx/d\alpha = 4\{w_X e_X(1-\gamma_{yz}^2) - w_Y e_Y(\gamma_{xy} - \gamma_{yz}\gamma_{xz})\}/\Delta\,, \tag{10a}$$

$$dy/d\alpha = 4\{w_Y e_Y(1-\gamma_{xz}^2) - w_X e_X(\gamma_{xy} - \gamma_{xz}\gamma_{yz})\}/\Delta\,, \tag{10b}$$

$$dz/d\alpha = 4\{w_X e_X(\gamma_{xy}\gamma_{yz} - \gamma_{xz}) - w_Y e_Y(\gamma_{yz} - \gamma_{xz}\gamma_{xy})\}/\Delta\,. \tag{10c}$$

Given the assumptions $w_X e_X \le w_Y e_Y < w_Z$ and (2), we obtain unambiguously,

$$dy/d\alpha < 0\,, \tag{10b'}$$

$$dz/da > 0\,. \tag{10c'}$$

Proof: (i). We first prove (10b'). Using (2) and $0<\gamma_{xz}<1$, we have $0 < \gamma_{xz}^2 < \gamma_{xz}\gamma_{yz}$. With $0<\gamma_{xy}<1$, it leads to $(1-\gamma_{xz}^2) > (\gamma_{xy} - \gamma_{xy}\gamma_{yz})$. Invoking $w_Y e_Y \ge w_X e_X > 0$ further yields $w_Y e_Y(1-\gamma_{xz}^2) > w_X e_X(\gamma_{xy} - \gamma_{xy}\gamma_{yz})$. Since $\Delta < 0$, we finally obtain

$$dy/d\alpha = 4\{w_Y e_Y(1-\gamma_{xz}^2) - w_X e_X(\gamma_{xy} - \gamma_{xy}\gamma_{yz})\}/\Delta < 0\,.$$

(ii). Now we prove (10c'). Condition (2) also implies $\gamma_{yz} > \gamma_{yz}\gamma_{xy}$ and $\gamma_{xz} > \gamma_{xz}\gamma_{xy}$, which leads to $(\gamma_{xy}\gamma_{yz} - \gamma_{xz}) < (\gamma_{yz} - \gamma_{xz}\gamma_{xy})$. Multiplying $w_X e_X$ to the left side and $w_Y e_Y$ to the right side, and invoking $w_Y e_Y \geq w_X e_X > 0$ yields $w_X e_X(\gamma_{xy}\gamma_{yz} - \gamma_{xz}) < w_Y e_Y(\gamma_{yz} - \gamma_{xz}\gamma_{xy})$, which in turn gives:

$$dz / d\alpha = 4\{w_X e_X(\gamma_{xy}\gamma_{yz} - \gamma_{xz}) - w_Y e_Y(\gamma_{yz} - \gamma_{xz}\gamma_{xy})\} / \Delta > 0 . \qquad \text{QED}$$

The intuition is, as the currency of the home country depreciates against those of both FDI host countries, the MNE increases output at home and reduces production in the host country where the average cost is higher. Thus, the less competitive destination country becomes worse off under a coordinated currency appreciation. Conversely, an appreciation of the northern currency against both southern currencies will make the less competitive host country relatively better off.

The sign of (10a) is ambiguous. Given $w_Y e_Y \geq w_X e_X > 0$, we find that if $\gamma_{xy} > 1 - \gamma_{yz}(\gamma_{yz} - \gamma_{xz})$, then $dx / d\alpha > 0$. In other words, if the substitutability between the two southern goods is high enough, then northern depreciation will make the MNE raise production in country X. The intuition is as follows. Northern depreciation will reduce production in countries X and Y directly. However, because good *y* is the middle quality good, the reduced production in country Y will be shifted to two directions—to countries Z as well as X. It turns out that the shift to country X outweighs the direct reduction if the substitutability between goods *x* and *y* is high enough, resulting in a net increase of output *x*.

We are now in a position to summarize the results above as follows.

Proposition 3: *Under a Northern depreciation against both southern currencies, (i). production in the North increases; (ii). that in the middle-ranked country (in terms of cost and product quality) decreases; (iii). that in the lowest-ranked country increases if the substitutability between the two low-quality goods is sufficiently high.*

Finally, we look into how changes in the exchange rates affect the MNE's total world output. To save on notation, let $q = x + y + z$, then we obtain

$$dq / de_X = 4\alpha w_X \{(1-\gamma_{yz}^2) - (\gamma_{xy} - \gamma_{xz}\gamma_{yz}) + (\gamma_{xy}\gamma_{yz} - \gamma_{xz})\} / \Delta , \qquad (11a)$$

$$dq / de_Y = 4\alpha w_Y \{(1-\gamma_{xz}^2) - (\gamma_{xy} - \gamma_{xz}\gamma_{yz}) + (\gamma_{xy}\gamma_{xz} - \gamma_{yz})\} / \Delta , \qquad (11b)$$

$$\begin{aligned} dq / d\alpha = (4/\Delta)\{ & w_X e_X [(1-\gamma_{yz}^2) - (\gamma_{xy} - \gamma_{xz}\gamma_{yz}) + (\gamma_{xy}\gamma_{yz} - \gamma_{xz})] \\ & + w_Y e_Y [(1-\gamma_{xz}^2) - (\gamma_{xy} - \gamma_{xz}\gamma_{yz}) + (\gamma_{xy}\gamma_{xz} - \gamma_{yz})]\} \end{aligned} . \qquad (11c)$$

Rearranging (11a) to yield

$$dq / de_X = 4\alpha w_X (1-\gamma_{yz})(1+\gamma_{yz} - \gamma_{xy} - \gamma_{xz}) / \Delta < 0 . \qquad (11a')$$

That is, currency appreciation of the country with the lowest cost will reduce global production. Even though outputs in countries Y and Z may rise, it cannot offset the reduction in country X due to the appreciation-induced increase in production cost.

Similarly, condition (11b) can be rewritten as

$$dq / de_Y = 4\alpha w_Y (1-\gamma_{xz})(1+\gamma_{xz} - \gamma_{xy} - \gamma_{yz}) / \Delta , \qquad (11b')$$

whose sign is ambiguous. If $\gamma_{xy} < 1 + \gamma_{xz} - \gamma_{yz}$, then (11b') is negatively signed. That is, if the substitutability between *x* and *y* is sufficiently low (high), global output falls (rises) as a result of currency appreciation in country Y.

Equation (11c) measures the marginal change of global output as the northern currency depreciates against those of countries X and Y. It is in fact the sum of eqs. (11a) and (11b). Using eqs. (11a') and (11b'), it is straightforward to conclude that global production will decrease if $\gamma_{xy} < 1 + \gamma_{xz} - \gamma_{yz}$. However, global output increases if and only if $1 + \gamma_{xz} - \gamma_{yz} < \gamma_{xy}$ and $\frac{w_X e_X}{w_Y e_Y} < -\frac{(1-\gamma_{xz})(1-\gamma_{xy}+\gamma_{xz}-\gamma_{yz})}{(1-\gamma_{yz})(1-\gamma_{xy}+\gamma_{yz}-\gamma_{xz})}$ hold.

The above findings can be summarized as

Proposition 4: *Global production decreases (i). following a unilateral currency appreciation of the outsourcing destination country with the lowest cost, and (ii). following a unilateral appreciation in the other destination country or a coordinated appreciation in both destination countries, if* $\gamma_{xy} < 1 + \gamma_{xz} - \gamma_{yz}$.

4. Profit and Welfare Analysis

First, we investigate how currency revaluation affects the MNE's profits. Differentiating (4) with respect to e_X, e_Y, and α respectively yields

$$d\pi / de_X = -\alpha w_X x < 0, \tag{12a}$$

$$d\pi / de_Y = -\alpha w_Y y < 0, \tag{12b}$$

$$d\pi / d\alpha = -(w_X e_X x + w_Y e_Y y) < 0. \tag{12c}$$

Clearly, currency appreciation either in one southern country, or both, will undermine the profits of the MNE. From (12a)~(12c), we can state

Proposition 5. *Under global outsourcing, (i). An appreciation in the currency of either outsourcing destination countries reduces the profits of the northern MNE; (ii). An appreciation of the northern currency does the opposite.*

Conventionally, foreign currency appreciation would raise the profits of home firms, and home currency appreciation would do just the opposite. However, proposition 5 states that in the present model, exactly the opposite arises. This is so because we incorporate FDI outsourcing, under which the MNE allocates production to maximize global profits. When costs are lower in foreign countries than at home, foreign appreciation drives the MNE to shift production back home, increasing production costs, and in turn lowering profits. Similarly, home currency appreciation pushes the MNE to shift more production abroad, where cost is lower, leading to higher profits.

Now, we turn to the overall welfare of country Z, which consists of two parts: the MNE profits and consumer surplus,

$$\Phi = \pi + U(x, y, z) - xp_x - yp_y - zp_z . \tag{13}$$

Differentiating with respect to e_X, e_y and α, and substituting in relevant expressions yields

$$\frac{d\Phi}{de_X} = \alpha w_X x(3 + 2\gamma_{xz}\gamma_{xy}\gamma_{yz} - \gamma_{xz}^2 - \gamma_{yz}^2 - \gamma_{xy}^2)/\Delta < 0, \tag{14a}$$

$$\frac{d\Phi}{de_Y} = \alpha w_Y y(3 + 2\gamma_{xz}\gamma_{xy}\gamma_{yz} - \gamma_{xz}^2 - \gamma_{yz}^2 - \gamma_{xy}^2)/\Delta < 0, \tag{14b}$$

$$\frac{d\Phi}{d\alpha} = \frac{1}{\alpha}(e_X \frac{d\Phi}{de_X} + e_Y \frac{d\Phi}{de_Y}) < 0. \tag{14c}$$

These results can be restated as follows.

Proposition 6: *Welfare in the northern country falls if either southern currency appreciates, or if the northern currency depreciates*.

Proposition 6 follows from proposition 5. When global outsourcing is possible, currency appreciation in either or both southern countries will cause the MNE to shift production to a country with higher costs before appreciation, leading to higher overall costs and lower profits for the MNE. The MNE thus reduces global output, which in turn lowers consumer surplus. The total effects on welfare in country Z are negative. Thus, the northern country will be worse off if its currency depreciates against those of its outsourcing destinations, which is in stark contrast with the case in the absence of global outsourcing.

5. Concluding Remarks

Using a three-country model, we have analyzed how exchange rates affect the MNE's global outsourcing decisions, which cause important consequences on production/employment, profits and welfare. Several contrasting and unconventional findings emerge. A currency appreciation in the southern country (X) producing the lowest-quality good with the least cost may reduce production in the North, while an appreciation in the other southern currency (Y) always does the opposite. A northern depreciation against both southern currencies may increase production in country X, but always reduces that in country Y. Under global outsourcing, northern welfare always falls following southern currency appreciations. The implications are, commercial policies targeting the currency appreciation of a single trading partner with low costs will likely not improve domestic employment, neither strengthen the global competitiveness of domestic firms, but on the contrary undermine the national welfare as well as the profits of home MNEs.

We believe this simple model and its predictions can shed light on the current China debate. While products bearing the "Made in China" label are gaining popularity, they are mainly low-

quality, low-price manufacturing goods. As multiple countries are involved in MNEs' global outsourcing activities, and substitutable goods from various countries compete in the global market, appreciation of the Chinese currency will drive consumers to substitute for goods made in other southern countries, leading the MNEs to shift production there. Thus, production and employment in China decrease. In addition, those in the MNEs' home countries may also decrease. It is questionable that MNEs will move plants back to the North, such as the USA or Japan, simply because there are many other southern countries that could be used as outsourcing destinations.

The analysis is based on the assumption that China produces the lowest quality good with the least cost, which is largely true at present. If after some years wages and other costs increase along with product quality in China, then it becomes the middle quality country and the predictions of country Y apply, compared with some other country X, such as Cambodia.

We have investigated the impact of exchange rate changes. The mechanism is the same if production costs increase in the outsourcing destination countries. Further, commercial policy such as tariffs can be incorporated in the model. Suppose final output is only consumed in country Z, increases in import tariffs cause identical effects as currency appreciations in the southern countries.

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Notes

1. For instance, the ASEAN-4 (Indonesia, Malaysia, Thailand, and the Philippines) had been the prime destination of Japanese FDI in manufacturing in Asia. In 1990, Japanese manufacturing FDI in China accounted merely 5 percent of its Asian total. However, as the yuan devalued sharply after 1990, China became a relatively cheaper production base. Japanese manufacturing FDI in China surged significantly in 1995 to 47 percent of its total in Asia.

2. For example, some U.S. lobby groups allege that the Chinese currency had made lots of American workers jobless. The U.S. Senate even voted on April 6, 2005 to increase tariffs on Chinese imports to 27.5% if China does not revaluate the yuan within 6 months. Former Japanese Finance Minister M. Shiokawa repeatedly accused China of "exporting deflation" to Japan.

3. See also the literature on the new FDI theory (e.g., Ethier, 1986; Helpman, 1985; Markusen, 1984), in which FDI does not need to involve physical capital movement abroad. Incorporating explicit capital investment in the present model complicates the algebra without adding essential insights.