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Production relocation and the effect of monetary policy

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Abstract

This paper analyzes the macroeconomic effect of production relocation by using an open economy macroeconomic model. Our analysis shows, paradoxically, that acceleration in production relocation might have an expansive effect on the home economy. We also show that monetary expansion has welfare-enhancing effects even in an economy where production relocation takes place. However, we can find that the size of the effects of monetary policy vary with the existence of production relocation. The existence of production relocation amplifies the effect of policy on the exchange rate but reduces it in regard to the relative home income.

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1. Introduction

Recently, a large number of Japanese firms have shifted their production position abroad, especially to China most recently. Hence, many economists and policy makers worry about the "hollowing out" of Japanese industry.

According to conventional wisdom, production relocation substitutes for domestic investment in plant and machinery; therefore, it is certainly regarded as the main factor of the "hollowing out" of domestic industry. However, for instance, the Japanese economy experienced an unprecedented boom in the second half of the 1980's in spite of an increase in foreign direct investment (and production relocation). The Taiwanese economy also experienced long-run growth until recently, despite accelerating production relocation. How should we regard these phenomena? [1] As well, how should the government respond to the situation, in case production relocation affects the domestic economy in a deflationary way?

In recent years, some Japanese economists have asserted the effectiveness of the depreciation strategy (of Japanese Yen) as a way to escape Japan's economic stagnation. Certainly, it seems that depreciation of Yen is an effective measure to re-vitalize the

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[1] Despite that the impact of production relocation has already been recognized, all but a few theoretical analyses of multinational enterprises (MNEs) or FDI concern trade theory. For instance, Markusen and Maskus (2001) is an up to date survey.

Japanese economy through an expansion of Japanese exports.[2] However, if many of the

domestic production processes are relocated abroad, the depreciation of the currency

may not aid in the expansion of exports. In addition, we should note that this

depreciation strategy (, which contains the macroeconomic policy that induces

depreciation,) might be rejected by foreign governments, because it is believed that this

policy may become a beggar-thy-neighbor policy.

According to the standard theoretical inference of the beggar-thy-neighbor problem

presented by the Mundell-Fleming-Dornbusch model, a country benefits from

depreciation of their currency (and expansion of their exports), but other countries

experience losses. On the other hand, Obstfeld and Rogoff (1995, 1996) point out that a

macroeconomic policy that induces the depreciation of domestic currency is equally

beneficial to all countries.[3]

The main purpose of this paper is to make clear the impact of the existence of

production relocation on macroeconomy. We especially focus on whether the shift of

production position affects the efficacy of macroeconomic policy.

The paper is organized as follows: In section 2 we construct a two-country

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[2] Many empirical studies have noticed the degree of exchange rate pass-through to prices. See, for instance, Goldberg and Knetter (1997).

[3] Tille (2001) presents a more generalized model that focuses on the intermediaries, and shows the possibility that monetary expansion causes either a beggar-thy-neighbor / prosper-thyself or a beggar-thyself / prosper-thy-neighbor effect.

macroeconomic model that contains the production relocation mechanism. The structure of the model is based on Obstfeld and Rogoff (1995), but ours is a static version of their model. Section 3 examines the effects of production relocation on national economies, and we show that the conventional wisdom doesn't always hold true. Section 4 examines the effects of monetary expansion in home and foreign countries, and in Section 5, we examine whether the existence of production relocation affects the efficacy of monetary expansion by using a linearized version of our model. As a result, we find that the monetary expansion in any country becomes a prosper-thyself / prosper-thy-neighbor policy under the assumption that production relocation exists in the economy. Moreover, we also find that the existence of production relocation can amplify the magnitude of the monetary policy effect to the exchange rate (terms of trade), but reduces it to the "relative" home national income. Finally, the last section provides some concluding remarks.

2. The model

We assume a world of two countries, Home (H) and Foreign (F). The representative household in each country consumes goods indexed by interval $[0,1]$. The utility function of the household in country H is written as follows:

$$u = s \ln L + (1-s) \ln C, \quad 0 < s < 1, \tag{1}$$

where $C = \left[\int_0^1 (c_i)^\rho \, di \right]^{\frac{1}{\rho}}$ $(0 < \rho < 1)$. L is the money demand, c_i is the consumption

of goods i, and C is the aggregate consumption.

The household solves their utility maximization subject to the budget constraint:

$$L + C = \frac{M_0}{P} + \tau + z. \tag{2}$$

The government budget constraint in country H is $\tau = (M - M_0)/P$. We now have the

following demand functions:

$$L = s\left(\frac{M}{P} + z\right), \quad C = (1-s)\left(\frac{M}{P} + z\right), \quad c_i = \left(\frac{p_i}{P}\right)^{\frac{1}{\rho-1}} C, \tag{3a, b, c}$$

where $P = \left[\int_0^1 (p_i)^{\frac{\rho}{\rho-1}} di \right]^{\frac{\rho-1}{\rho}}$. P is the price index of p_i, M is the nominal money

supply, M_0 is the money holding at the beginning of period, τ is the transfer from the

government, and z is the real national income. We assume that the behavior of the

foreign household is the same as that of the home household.

The goods indexed by interval $[\alpha, 1]$ are produced in country H, and the rest of the

goods ($i \in [0, \alpha]$) are produced in country F. We assume that the goods indexed by $[\beta, 1]$

are produced by home firms, and the goods indexed by $[0, \beta]$ are produced by foreign

firms ($0 < \beta < \alpha < 1$). Note that, under these assumptions, the goods of interval $[\beta, \alpha]$

are produced by the home multinational enterprises (MNEs) located in country F.

The profit function of the firm, which produces goods i in country H, is given by

$$\pi_i = p_i c_i + e p_i^* c_i^* - w l_i, \quad i \in [\alpha, 1], \tag{4}$$

where, asterisks denote foreign variables. We assume that labor is the only input used to produce goods, with its amount given as simply $l_i = c_i + c_i^*$. Each firm takes the wage rate as a given, choosing the optimal price level.[4]

$$p_i = \frac{w}{\rho} \equiv p_H, \quad p_i^* = \frac{w}{e\rho} \equiv p_H^*, \quad i \in [\alpha, 1]. \tag{5a, b}$$

We assume that all firms in country F strive similarly to maximize profit, and we have

$$p_i = \frac{e w^*}{\rho} \equiv p_F, \quad p_i^* = \frac{w^*}{\rho} \equiv p_F^*, \quad i \in [0, \alpha]. \tag{5c, d}$$

The subscripts H and F in (5a) - (5d) show the country where the goods are produced. For instance, p_H^* is the price of goods produced by the firms in country H and are sold in country F.

Substituting (5a) - (5d) into the price indexes, and we obtain

$$P = p_H \left[\alpha(\varepsilon)^{\frac{\rho}{\rho-1}} + (1-\alpha) \right]^{\frac{\rho-1}{\rho}}, \quad P^* = p_F^* \left[\alpha + (1-\alpha)\left(\frac{1}{\varepsilon}\right)^{\frac{\rho}{\rho-1}} \right]^{\frac{\rho-1}{\rho}}, \tag{6a, b}$$

where $\varepsilon \equiv e p_F^* / p_H$ and e is the nominal exchange rate. Therefore, we derive that $P = e P^*$, which describes the expression of purchasing power parity.[5]

The equilibrium conditions of the money market and goods market are shown as

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[4] For an introduction of the nominal wage determinant into an open economy macroeconomic model, see Fender and Yip (1994).

[5] In the presence of a "producer's currency pricing (PCP)", PPP comes into existence. However, we assume a "pricing-to-market (PTM)" behavior, PPP doesn't come into existence. See, for instance, Betts and Devereux (1996, 2000).

$$\frac{M}{P} = L, \quad \frac{M^*}{P^*} = L^*, \quad y = \gamma\left(C + C^*\right), \quad y^* = \left(1 - \gamma\right)\left(C + C^*\right), \tag{7a, b; 8a, b}$$

where $y \equiv p_H Y / P$, $y^* \equiv p_F^* Y^* / P^*$, and γ is the propensity to spend the goods produced in country H, which is shown as

$$\gamma \equiv \left(1 - \alpha\right)\left(\frac{p_H}{P}\right)^{\frac{\rho}{\rho-1}} = \left(1 - \alpha\right)\left[\alpha(\varepsilon)^{\frac{\rho}{\rho-1}} + \left(1 - \alpha\right)\right]^{-1}. \tag{9}$$

We now define that $p \equiv P / p_H$, $p^* \equiv P^* / p_F^*$, $m \equiv M / p_H$, $m^* \equiv M^* / p_F^*$. Using (3a), (3b), and foreign counterparts, (6a, b), (7a, b), (8a, b) are then rewritten as

$$p = \left[\alpha(\varepsilon)^{\frac{\rho}{\rho-1}} + \left(1 - \alpha\right)\right]^{\frac{\rho-1}{\rho}}, \quad p^* = \left[\alpha + \left(1 - \alpha\right)\left(\frac{1}{\varepsilon}\right)^{\frac{\rho}{\rho-1}}\right]^{\frac{\rho-1}{\rho}}, \tag{10a, b}$$

$$\frac{m}{p} = \left(\frac{s}{1-s}\right)z, \quad \frac{m^*}{p^*} = \left(\frac{s}{1-s}\right)z^*, \tag{10c, d}$$

$$y = \gamma\left(1 - s\right)\left[\left(\frac{m}{p} + z\right) + \left(\frac{m^*}{p^*} + z^*\right)\right], \quad y^* = \left(1 - \gamma\right)\left(1 - s\right)\left[\left(\frac{m}{p} + z\right) + \left(\frac{m^*}{p^*} + z^*\right)\right], \tag{10e, f}$$

We now assume that the MNEs remit all of their profits to country H, and the real national incomes are then given by

$$z = y + \theta\, y^*, \quad z^* = y^* - \theta\, y^*, \tag{10g, h}$$

where $\theta \equiv \left(1 - \rho\right)\left(1 - \frac{\beta}{\alpha}\right)$. We can easily find that $0 < \theta < 1$. The system (10a) - (10h) gives seven unknowns ($p, p^*, \varepsilon, y, y^*, z, z^*$). One equation is redundant by Walras' law.

Using (9), (10a) - (10e), (10g), (10h), and the definition of θ, we derive

$$\frac{m}{p(\varepsilon; \alpha)} = \left(\frac{s}{1-s}\right)z, \quad p_\varepsilon > 0, \tag{11a}$$

$$z = \left\{ 1 - \left(1 - \gamma(\varepsilon; \alpha)\right)\left(1 - \theta(\alpha)\right) \right\}\left(\frac{1-s}{s}\right)\left(\frac{m + \varepsilon m^*}{p(\varepsilon; \alpha)}\right), \quad \gamma_\varepsilon > 0, \gamma_\alpha < 0, \theta_\alpha > 0, \tag{11b}$$

7

where the sign of p_α can't be strictly determined. From the differentiation of (10a) and (10b), we can find the following relationships:

$$\begin{cases} \varepsilon < 1 \leftrightarrow p_\alpha < 0, \; p_\alpha^* < 0, \\ \varepsilon \geq 1 \leftrightarrow p_\alpha \geq 0, \; p_\alpha^* \geq 0. \end{cases}$$

However, $\varepsilon \geq 1$ isn't plausible in our model; if the price of domestic goods is less than or equal to that of foreign goods, firms will have no incentive to relocated their production position abroad. Therefore, in Section 3, we examine only in the case that $\varepsilon < 1$.

By differentiating (11a) and (11b), we obtain the Jacobian (J) of this system:

$$J \equiv \begin{pmatrix} -\dfrac{mp_\varepsilon}{p^2} & -\dfrac{s}{1-s} \\ A & -1 \end{pmatrix}, \tag{12}$$

where

$$A \equiv \left(\frac{1-s}{s}\right)\left[(1-\theta)\gamma_\varepsilon\left(\frac{m+\varepsilon m^*}{p}\right) - \{1-(1-\gamma)(1-\theta)\}\left\{\left(\frac{mp_\varepsilon}{p^2}\right) - \left(\frac{m^*}{p}\right)\left(1-\frac{\varepsilon p_\varepsilon}{p}\right)\right\}\right],$$

and the sign of this can't be strictly determined. However, the sign of Jacobian determinant (Δ) is strictly positive:

$$\begin{aligned} \Delta \equiv {} & (1-\theta)\gamma_\varepsilon\left(\frac{m+\varepsilon m^*}{p}\right) + (1-\gamma)(1-\theta)\left(\frac{mp_\varepsilon}{p^2}\right) \\ & + \{1-(1-\gamma)(1-\theta)\}\left(\frac{m^*}{p}\right)\left(1-\frac{\varepsilon p_\varepsilon}{p}\right) > 0, \end{aligned} \tag{13}$$

As the $trace\ J \equiv -\dfrac{mp_\varepsilon}{p^2} - 1 < 0$, the stability conditions of this system are satisfied.

3. Does production relocation always affect the home economy deflationary?

In this section, we regard an increase in α as the advance of production relocation, and examine its effect on z and ε by using (11a) and (11b). The results of comparative statics are shown as below:

$$\frac{d\varepsilon}{d\alpha} = -\left(\frac{1}{\Delta}\right)\left\{\frac{mp_\alpha}{p^2} + \left(\frac{s}{1-s}\right)B\right\}, \quad \frac{dz}{d\alpha} = \left(\frac{1}{\Delta}\right)\left\{\left(\frac{mp_\varepsilon}{p^2}\right)B - \left(\frac{mp_\alpha}{p^2}\right)A\right\}, \qquad \text{(14a, b)}$$

where,

$$B \equiv \left(\frac{1-s}{s}\right)\left(\frac{m+\varepsilon m^*}{p}\right)\left[(1-\theta)\gamma_\alpha + (1-\gamma)\theta_\alpha - \left\{1-(1-\gamma)(1-\theta)\right\}\left(\frac{p_\alpha}{p}\right)\right].$$

The sign of B can't be determined. The results of (14a) and (14b) can be arranged as follows:

- **Case 1 ($A > 0$):**

  (a) if $B > 0$, the sign of $d\varepsilon/d\alpha$ can be either positive or negative, but $dz/d\alpha > 0$.

  (b) if $B < 0$, $d\varepsilon/d\alpha > 0$, but the sign of $dz/d\alpha$ can be either positive or negative.

- **Case 2 ($A < 0$):**

  (a) if $B > 0$, the sign of both $d\varepsilon/d\alpha$ and $dz/d\alpha$ can be either positive or negative.

  (b) if $B < 0$, $d\varepsilon/d\alpha > 0$ and $dz/d\alpha < 0$.

In case 1-(a), we have the paradoxical result that the advance of production relocation has an expansive effect on the home country. Moreover, we should notice that there is a possibility of having this paradoxical result also in cases 1-(b) and 2-(a).

We now interpret these results intuitively. We call (11a) "AA schedule: money market equilibrium", which has a negative slope, and (11b) "DD schedule: goods market equilibrium". The slope of "DD schedule" can be either positive or negative. If $A > 0$, the DD schedule has a positive slope (corresponding to Case 1), but if $A < 0$, it has a negative one (Case 2).

From (11a), we can see that the advance of production relocation affects the money market only by the price variation. In the case that $p_\alpha < 0$, this effect is shown as the right-side shift of AA schedule in both cases (Cases 1 and 2).

From (11b), we can find that the advance of production relocation affects the goods market through three passes. First, the advance of production relocation decreases the national income by reducing the propensity to spend, γ (expenditure-switching-effect). This effect is shown as the shift of DD schedule to the left in both cases (Cases 1 and 2). Second, the advance of production relocation increases the national income by reducing prices (p, p^*) in the case that $p_\alpha < 0$ (price-effect). Finally, the spread of production relocation increases the national income by an increase in remittance from MNEs (investment-income-effect). Both price-effect and investment-income-effect are shown as the right-side shift of DD schedule in either case.

Figure 1.

Figure 2.

Figures 1 and 2 show the effect of an increase in α to the exchange rate (terms of trade) and national income of country H. If the expenditure-switching-effect is stronger than the combination of price-effect and the investment-income-effect, our short-run equilibrium shifts from point 0 to point 1 in both figures. On the other hand, when either the price-effect or the investment-income-effect (or the combined effect) is stronger than the expenditure-switching-effect, the equilibrium shifts to point 2 in both figures.

Proposition 1: Contrary to conventional wisdom, the advance of production relocation doesn't necessarily have a contractionary effect on the home country, and may have an expansive effect. Especially, if either the price-effect or the investment-income-effect (or the combined effect) is stronger than the expenditure-switching-effect, we must have the paradoxical result that the advance of production relocation increases the home national income in the case that DD schedule has a positive slope.

4. The effect of the monetary policy

In this section, we examine the effect of monetary expansion.[6] Totally differentiating (11a) and (11b) and using standard procedures, we have

$$\frac{d\varepsilon}{dm} = \left(\frac{1}{\Delta}\right)\left(\frac{1}{p}\right)(1-\gamma)(1-\theta) > 0, \tag{15a}$$

$$\frac{dz}{dm} = \left(\frac{1}{\Delta}\right)\left(\frac{1}{p}\right)\left(\frac{1-s}{s}\right)\left[(1-\theta)\gamma_\varepsilon\left(\frac{m+\varepsilon m^*}{p}\right) + \left\{1-(1-\gamma)(1-\theta)\right\}\left(\frac{m^*}{p}\right)\left(1-\frac{\varepsilon p_\varepsilon}{p}\right)\right] > 0. \tag{15b}$$

The monetary expansion in country H stimulates the home consumption demand, and increase domestic production. Moreover, an increase in m in the home money market raises the level of ε (e). The rise in the level of ε increases the world consumption demand of the domestic commodity, and the level of γ rises (see (9)). The rise in the level of ε also decreases the level of p^*, hence the consumption demand in country F increases. In our model, a part of the foreign consumption demand contains the demand for the goods produced in country H. Therefore, an increase in the foreign consumption demand leads an increase in production and national income level (z) in country H. On the other hand, the rise in the level of p (because of the rise in ε) decreases the consumption demand in country H. However, the sum of these effects certainly increases the ultimate national income level of country H.

The effects of monetary expansion in country F on country H are shown as

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[6] We can easily examine the fiscal policy effect by imposing a slight modification of our model, according to the Obstfeld and Rogoff (1995) settings.

$$\frac{d\varepsilon}{dm^*} = -\left(\frac{1}{\Delta}\right)\left(\frac{\varepsilon}{p}\right)\{1-(1-\gamma)(1-\theta)\} < 0, \tag{15c}$$

$$\frac{dz}{dm^*} = \left(\frac{1}{\Delta}\right)\left(\frac{\varepsilon}{p}\right)\left(\frac{1-s}{s}\right)\{1-(1-\gamma)(1-\theta)\}\left(\frac{mp_\varepsilon}{p^2}\right) > 0. \tag{15d}$$

An increase in m^* stimulates the foreign consumption demand. As we noted above, part of the foreign consumption demand contains the demand for the goods produced in country H in our model; therefore, both the home production and national income levels increase.

The effects of monetary expansion on the foreign economy can be considered the same as that on the home economy; therefore, we introduce only the results of our comparative statics.[7] Moreover, the effects of monetary expansion on the terms of trade have already been explained. Hence we show only the effects on the foreign national income:

$$\frac{dz^*}{dm} = -\left(\frac{1}{\Delta^*}\right)\left(\frac{1}{p^*}\right)(1-\gamma)(1-\theta)\left(\frac{1-s}{s}\right)\left(\frac{m^*p_\varepsilon^*}{p^{*2}}\right) > 0, \tag{16a}$$

$$\frac{dz^*}{dm^*} = \left(\frac{1}{\Delta^*}\right)\left(\frac{1}{p^*}\right)\left(\frac{1-s}{s}\right)\left[(1-\theta)\gamma_\varepsilon\left(\frac{m+\varepsilon m^*}{\varepsilon p^*}\right) + (1-\gamma)(1-\theta)\left(\frac{m}{\varepsilon p^*}\right)\left(\frac{1}{\varepsilon} + \frac{p_\varepsilon^*}{p^*}\right)\right] > 0, \tag{16b}$$

where

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[7] Using (10a) - (10d), (10f) - (10h), we obtain the money and goods market equilibrium conditions in country F. Totally differentiating these conditions and using the standard procedure, we can derive (16a) and (16b).

$$\Delta^{*} \equiv (1-\theta)\gamma_{\varepsilon}\left(\frac{m+\varepsilon m^{*}}{\varepsilon p^{*}}\right) - \left\{1-(1-\gamma)(1-\theta)\right\}\left(\frac{m^{*}p_{\varepsilon}^{*}}{p^{*2}}\right)$$

$$+ (1-\gamma)(1-\theta)\left(\frac{m}{\varepsilon p^{*}}\right)\left(\frac{1}{\varepsilon}+\frac{p_{\varepsilon}^{*}}{p^{*}}\right) > 0.$$

Monetary expansion in country F also increases the national incomes in both countries

in our model.

   We now examine the welfare effect of the monetary expansion. Using (1), (3a), (3b),

(10c), (10d), and the government budget constraint, we have

$$\frac{du}{dx} = \left(\frac{1}{z}\right)\left(\frac{dz}{dx}\right) > 0, \quad \frac{du^{*}}{dx} = \left(\frac{1}{z^{*}}\right)\left(\frac{dz^{*}}{dx}\right) > 0, \qquad \text{(17a, b)}$$

where $x = m$, m^{*}. From (17a, b), we find that the monetary expansion in any country

certainly improves the welfare of all countries. Therefore, we can say that the inference

of Obstfeld and Rogoff (1995, 1996), which holds that monetary expansion becomes a

welfare-enhancing policy for all countries, is robustly held, in spite of our modification

of introduced production relocation.

   Proposition 2: Monetary expansion in any country become a prosper-thyself /

prosper-thy-neighbor policy, even in an economy where production relocation takes

place.

   However, the question arises as to whether the efficacy of the monetary policy in an

economy where the production relocation exists is strictly equal to that in the case in which production relocation doesn't exist. We will clarify this question in the following section.

5. The existence of production relocation and the effect of the money policy

We examine whether production relocation affects the results of monetary policy. To answer this question, we compare the economy where production relocation exists, which is shown as the system (10a) - (10h), with the economy where it doesn't exist.

First, we solve the system (10a) - (10h) by linear-approximation around the initial equilibrium.[8] Let $\hat{x} \equiv dx/\bar{x}$ for any variable x, where $\bar{x}$ shows the initial (zero-shock) equilibrium value. Using (9) and the linearized version of (10a) - (10e), (10g), (10h), we have the following equations:

The MM schedule: $\hat{\varepsilon} = (\hat{m} - \hat{m}^*) - (\hat{z} - \hat{z}^*),$ (18a)

The $G^\alpha G^\alpha$ schedule: $\hat{\varepsilon} = \left(\frac{1-\rho}{\rho}\right)\left(\frac{\bar{y} + \theta\,\bar{y}^*}{\bar{y}}\right)(\hat{z} - \hat{z}^*),$ (18b)

where the sign of coefficient of $(\hat{z} - \hat{z}^*)$ in (18b) is positive.

If production relocation doesn't exist in our modal, the parameter α will be equal to β. In this case, (18b) is accommodated as

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[8] See Obstfeld and Rogoff (1995, 1996).

15

The $G^\beta G^\beta$ **schedule:** $\hat{\varepsilon} = \left(\dfrac{1-\rho}{\rho}\right)\left(\hat{z} - \hat{z}^*\right).$ (18c)

However, the MM schedule doesn't change at all.

Figure 3.

Figure 3 illustrates the effect of the money supply shock (rise in the relative home money supply; $\hat{m} - \hat{m}^*$) on the two different types of economies. The MM schedule shows the relationship between the change of relative national income and change in the nominal exchange rate (terms of trade). The relative national income changes affect the level of the exchange rate by changing the relative money demand. Note that, prior to the money shock, the MM schedule passes through the origin. Next, both the $G^\alpha G^\alpha$ and $G^\beta G^\beta$ schedules are shown as upward-sloping graphs. The depreciation of home currency raises relative home output and relative national income; both schedules therefore are drawn as upward-sloping graphs. Moreover, we should note that the slope of the $G^\alpha G^\alpha$ schedule is steeper than that of $G^\beta G^\beta$, because $1 < \dfrac{\bar{y} + \theta\,\bar{y}^*}{\bar{y}}$.

In an economy where production relocation exists, the money supply shock shifts the short-run equilibrium from the origin to point 1. On the other hand, it shifts the equilibrium to point 2 when production relocation doesn't exist. We can see that the money supply shock raises relative home national income and causes the depreciation of home currency in both cases in Figure 3. However, by comparing these two cases we can

easily find that the magnitude of the exchange rate change caused by the money supply

shock, which occurs when production relocation takes place, is larger than that which

takes place when production relocation doesn't take place. On the other hand, the

existence of production relocation must weaken the money shock effect on the relative

home national income. These results strongly depend on the existence of profit

remittance. If the profit remittance doesn't exist in our model ($\theta = 0$), the $G^\alpha G^\alpha$

schedule must be equal to $G^\beta G^\beta$. (See (18b, c).) Therefore, the difference of the money

shock effects shown in Figure 3, disappears in the case that $\theta = 0$. On the other hand,

as $\theta \to 1$, the difference becomes larger. In addition, as the level of α increases, the

level of θ also increases, because $\theta \equiv (1 - \rho)\left(1 - \dfrac{\beta}{\alpha}\right)$. Therefore, if production

relocation accelerates, the difference of the money shock effects shown in Figure 3

becomes larger. Moreover, the level of θ also depends on β (all variety of goods /

firms in the world) and ρ ($1/(1 - \rho)$ is the elasticity of substitution). If β and / or ρ

becomes large, the level of θ decreases, and the difference of the money shock effects

becomes small.

Proposition 3: The existence of production relocation affects the magnitude of the

effects of monetary policy. It amplifies the policy effect on the exchange rate (terms of

trade) but reduces the policy effect on the relative home national income. Moreover,

advancing of production relocation makes this tendency stronger.

6. Conclusions

This paper examines the effect of production relocation on national economies. Our model is the static version of a famous open economy macroeconomic model, presented by Obstfeld and Rogoff (1995), in the presence of production relocation. From our simple analysis, we can find that the advance of production relocation doesn't necessarily have a contractionary effect on the home economy, and may have an expansive effect, contrary to conventional wisdom. Moreover, we are also interested in the effects of macroeconomic policy in the world where the production relocation exists. From our analysis, we find that monetary expansion in any country must have expansive effects on the national incomes and must certainly also improve the welfare of all countries. Therefore, we can conclude that monetary policy becomes a "prosper-thyself / prosper-thy-neighbor" policy, and the inference of Obstfeld and Rogoff holds even in a situation in which production relocation exists.

We also examine whether the magnitude of the effects of monetary policy is affected by the existence of production relocation. Analysis using the linearized version of our

model produces the clear result that the existence of profit remittance, which is

accompanied by production relocation, amplifies the effects of monetary policy on the

exchange rate but reduces the policy's effect on the relative home national income.

Moreover, advancing production relocation makes this tendency stronger.

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Tille, C. (2001) The Role of Consumption Substitutability in the International Transmission of Monetary Shocks, *Journal of International Economics*, 53, 421-444.

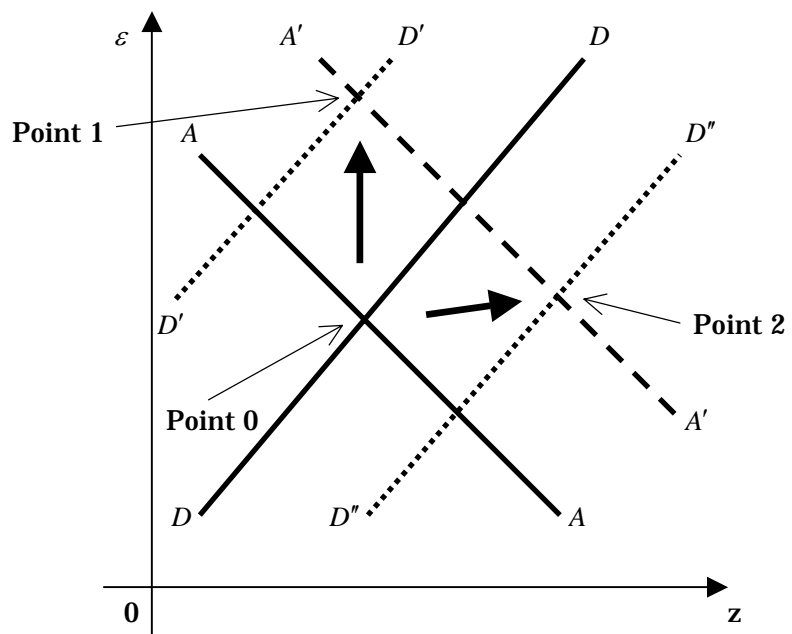**Figure 1: The effect of an advance of production relocation (Case 1)**

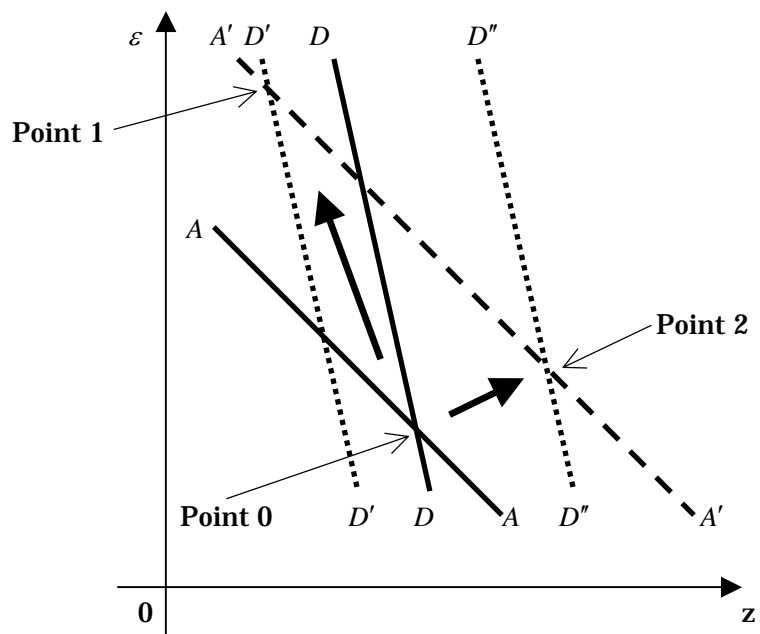**Figure 2: The effect of an advance of production relocation (Case 2)**

Figure 3: Effects of monetary expansion in two different economies.