論 説

National income, unemployment and a free-trade zone: A two-area analysis*)

Kazuhiro Tetsu

1. Introduction

Nowadays many developing countries establish the area called free-trade zones (FTZs), because it is believed that the establishment of FTZs brings the host countries various benefits. The benefits which the host countries expect, for example, are an increase in employment, a contribution to acquiring foreign currency and a transfer of new technology, and owing to them national income may increase. In this paper, we focus on the welfare and employment effects of the promotion of the FTZ particularly.

In a recent theoretical study concerning this issue, Young (1987), which assumes that there is full employment in the host country, shows that there is the possibility that the formation of a free-trade zone makes national income decrease. His model shows such a negative conclusion, while the Young and Miyagiwa (1987) model shows that the formation of a free-trade zone always increases national income.[1)] The feature in their model is to introduce urban unemployment *à la* Harris-Todaro (1970).[2)] Because mass urban unemployment is still one of the most troublesome issues for developing countries, we also believe, like the Young and Miyagiwa (1987) model, that it is important to introduce urban unemployment into the model when we deal with the issues of developing economies.

However, the simple introduction of urban unemployment is not sufficient to express the situation in developing countries. Considering economy in developing countries, we should note that there are two areas that have distinctive economic features. One is a big city area, which consists of processing industries. The other is a rural one, in which primary com-

*) I am deeply indebted to Professors Hiroshi Ohta and Noboru Kawanabe for their helpful comments and suggestions. Any remaining errors are solely my responsibility.

1) Chaudhuri and Adhikari (1993), which also introduces urban unemployment, shows that there is the possibility of decreasing in national income. The difference between the two models is that Chaudhuri and Adhikari (1993) incorporates intersectoral mobility of domestic capital.

2) See Harris and Todaro (1970).

modities are produced. In many developing countries, the big city area continues to develop, while the rural area remains poor. The difference in development between the two areas may derive from a fact that each economy behaves as if each area were a part of different countries. In particular, when we deal with the economic issues of island countries such as Philippine, Indonesia or countries with extensive territory such as China, we believe it is important to introduce the idea of the two-area model because of its geographical reason.

In this paper, we give the following assumptions to introduce the two-area model: The big city area has urban unemployment and the rural area has full employment. The city area with urban unemployment denotes the area surrounding the capital of the country, and it consists of the urban modern sector and the sub-urban sector.[3] The rural area with full employment is far away from the city area. There used to be an agricultural sector with disguised unemployment alone, but now a free-trade zone is established here. Therefore it consists of two sectors, namely, the agricultural sector and a free-trade zone. There is labor migration between the big city area and the rural area.

We assume that there are two types of workers, namely, skilled labor and unskilled labor. In the present paper, however, we can not state clearly whether the promotion of a FTZ increases urban unemployment or not, because two types of workers move to different directions respectively. The labor in the sub-urban sector, which are skilled labor, tries to move to the urban sector owing to a fall in the sub-urban wage originated in the formation of a FTZ, and thereby unemployed skilled labor increases. On the other hand, the unemployed unskilled labor in the urban sector want to go back to their native place, namely, the rural area owing to a rise in the rural wage originated in the promotion of a FTZ, and thereby unemployed unskilled labor decreases. Thus, whether aggregated urban unemployment increases or not depends on the degree of the increase in unemployed skilled labor and the decrease in unemployed unskilled labor.

In addition to analyzing urban unemployment, we examine the effect of the promotion of a FTZ on income in each area, and we get a result that income decreases in the city area and increases in the rural area. It shows an interesting result that national income depends heavily on the amount of skilled and unskilled labor in each area.

As stated above, the main objective of this paper is to present a bench mark model introducing the idea of the two-area, and to analyze the welfare and employment effects of a development strategy that the government in a developing country promotes a FTZ. In particular, we notice the effects of the establishment of a FTZ that aims at the development of the poor rural area. The results may give us a hint why developing countries are still

---

[3] Suppose that the sub-urban sector surrounds the urban modern sector, and it consists of many small firms such as a rice mill or a canning which uses agricultural products in area 2 as intermediate goods.

promoting the establishment of a FTZ, in spite of reaching negative conclusions in many past studies.[4]

In section 2 we first present a two-area model, and section 3 considers the effects of the tariff reduction on intermediate goods used in a FTZ on unemployment and output.[5] We also examine the welfare effect of the tariff reduction in section 4. In section 5 we conclude this paper.

2. The model

We consider a small open economy. This country is divided into two areas: area 1 and area 2. Area 1 consists of an urban modern sector and a sub-urban sector. In this area, there is unemployment. On the other hand, area 2 consists of a free-trade zone (FTZ) and an agricultural sector, but there is no unemployment in this area. The urban modern sector produces goods, M, with domestic capital and two types of domestic labor, that is, skilled labor and unskilled labor. The sub-urban sector produces goods, A, with domestic labor and intermediate goods which is produced in and transferred form area 2. The prices of those goods, M and A, are given internationally because of a small open economy assumption.

Next, we consider economic activities in area 2. The free-trade zone produces goods, f, with domestic labor, foreign capital and imported intermediate goods, which are traded at given international price. The agricultural sector produces goods, g, with domestic labor only, and the goods, g, are supplied to the sub-urban sector in area 1 as intermediate goods.[6]

In a small open economy, we can normalize all the prices of final goods to be unity without loss of generality. Assuming that all the markets are perfectly competitive and that there are constant returns to scale, we can express the zero profits conditions with unit cost functions, $C^i(\cdot)$ $(i = M, A, f, g)$ as

$$1 = C^M(\overline{W}, \overline{W_u}, R) \tag{1}$$

$$1 = C^A(W_A, P_g) \tag{2}$$

$$1 = C^f(W_g, r^*, P(1+t)) \tag{3}$$

$$P_g = C^g(W_g) \tag{4}$$

where $\overline{W}$ is the urban wage rate for skilled labor which is institutionally fixed at a higher level than the wage rate (W_A) prevailing in the sub-urban sector, $\overline{W_u}$ is the urban wage rate

[4] In Hamada (1974), Rodriguez (1976) and Hamilton and Svensson (1982), they assume that the formation of free-trade zones is accomplished by the reduction of the tariff on final goods, and they reach negative conclusion for developing countries.

[5] We assume that the promotion of a FTZ is accomplished by a tariff reduction on intermediate goods as well as Young (1987) and Young and Miyagiwa (1987).

[6] We assume that food is supplied to household through the sub-urban area in this country.

for unskilled labor which is fixed at a lower level than the wage rate in the sub-urban sector, R is the return to capital specific to the urban modern sector, W_g is the competitive wage rate prevailing in area 2, r^* is the world market return to capital specific to the free-trade zone, P is the price of the imported intermediate goods, P_g is the price of the agricultural goods, which are used as intermediate goods in the sub-urban sector, and t is the tariff rate on imports of the intermediate goods which are used in the FTZ.

There is labor migration between areal and area 2, labor in area 2 tries to migrate to a urban sector to get higher wage and city life. But, even if they get a job there, they are hired as just unskilled labor. On the other hand, in this model, when labor in the sub-urban sector get a job, they have no choice of getting a job as unskilled labor in the urban sector. They are hired as just skilled labor there. Therefore, in this model, there are two types of the unemployed labor, that is, the unemployed skilled labor and the unemployed unskilled labor. In accordance with the Harris-Todaro model, labor movement within area 1 is governed by expected wage equalization.[7] Thus, in the equilibrium in the labor movement, we can show the following equations,

$$W_A = \overline{W} C_W^M X_M / (C_W^M X_M + \nu) \tag{5}$$

$$W_g = \overline{W_u} C_{W_u}^M X_M / (C_{W_u}^M X_M + u) \tag{6}$$

where v, u are the level of unemployed skilled and unskilled labor, respectively. C_j^i is the partial derivative of the ith unit cost function ($i = M, A, f, g$) with respect to the jth factor price ($j = W, W_u, R, P$), and it gives the unit factor requirements (a_j^i) in each sector.[8]

We can express the equilibrium in the labor market as

$$C_W^M X_M + C_W^A X_A + \nu = \overline{L_s} \tag{7}$$

$$C_W^f X_f + C_W^g X_g + C_{W_u}^M X_M + u = \overline{L_i} \tag{8}$$

where $\overline{L_s}$, $\overline{L_i}$ are the amount of skilled and unskilled labor, respectively.

The full employment condition for capital can be written as

$$C_R^M X_M = \overline{K} \tag{9}$$

---

[7] The wage in the sub-urban sector equals the expected wage in the urban modern sector, where the expected wage in the urban modern sector is defined as the actual wage for skilled labor multiplied by the probability of being employed as skilled labor in the urban modern sector plus the actual wage for unskilled labor multiplied by the probability of being employed as unskilled labor in the urban modern sector.

[8] By the Shephard-Samuelson relations, we get $a_j^i = \partial C^i / \partial \pi_j$ where π_j is the price of factor j.

where $\overline{K}$ is the endowment of unelasitically supplied domestic capital. The equilibrium condition in the market for the agricultural sector's output can be expressed as

$$C_P^A X_A = X_g \tag{10}$$

Thus, our model consists of ten equations (1)-(10) which includes ten unknowns W_g, W_A, R, P_g, X_M, X_A, X_g, X_f, v, u.

3. The effects of a tariff reduction on unemployment and output

For developing countries, one of the attempts that attract foreign firms into the country is to promote a FTZ through tariff reduction on the intermediate goods used in the FTZ. The host countries, then, expect that urban unemployment decreases and national income increases. However, does the promotion of a FTZ actually bring the host countries such benefits? Thus, in this section, we examine the effects of tariff reduction on unemployment and the output in each sector.

In this model, given P and t, (3) determines W_g and (4) determines P_g. (2) then yields W_A. Given, $\overline{W}$, $\overline{W_u}$ (1) yields R. Now we examine the effect on urban unemployment. Differentiating eq. (5) with respect to t yields

$$dv/dt = -[(C_W^M X_M + v)/W_A](dW_A/dt) \tag{11}$$
$$du/dt = -[(C_{W_u}^M X_M + u)/W_g](dW_g/dt) \tag{12}$$

Since we already obtain $dW_g/dt < 0$ and $dW_g/dt > 0$, we get $dv/dt < 0$ and $du/dt > 0$. This means that a reduction in the tariff on imported intermediate goods increases urban unemployment of skilled labor and decreases one of unskilled labor. Since it is considered that the total urban unemployment, which is shown by the sign of V, consists of the unemployed skilled and unskilled labor in the urban area, the effect on the total urban employment of the tariff reduction is expressed as[9)]

$$dV/dt = dv/dt + du/dt \tag{13}$$

From eq. (13), in general, we can not conclude whether the tariff reduction increases the total urban unemployment or not because we have already got $dv/dt < 0$, $du/dt > 0$. However, we give the following proposition:

---

9) In this case, it may be inappropriate to add the unemployed skilled and unskilled labor simply. In developing countries, however, the absolute number of visible unemployed labor is the most important issue. Thus, we note the simple addition of unemployed labor regardless of the quality of labor.

Proposition 1. A reduction in the tariff on imported intermediate goods accompanying the promotion of the free-trade zone increases urban unemployment of skilled labor and decreases one of unskilled labor. As a result, the total unemployment may increase or decrease.

Next, we examine the change of the output in each sector. Differentiating eqs. (7), (8) and (10) with respect to t yields

$$dX_A/dt = -\{(dv/dt)+X_A(dC_W^A/dt)\}/C_W^A \tag{14}$$

$$dX_f/dt = -\{X_f(dC_W^f/dt)+C_W^g(dX_g dt)+X_g(dC_W^g/dt)+(du/dt)\}/C_W^f \tag{15}$$

$$dX_g/dt = X_A(dC_P^A/dt)+C_P^A(dX_A/dt) \tag{16}$$

Since $dC_W^A/dt \leq 0$, $dC_W^f/dt \geq 0$, $dC_W^g/dt \geq 0$, $dC_P^A/dt \geq 0$, given $dv/dt < 0$, eq. (14) gives $dX_A/\mathrm{dt} > 0$. Given $dX_A/dt > 0$, we obtain $dX_g/dt > 0$ with eq. (16). Finally, given $dX_g/dt > 0$, $du/dt > 0$, eq. (15) gives $dX_f/dt < 0$ (see Appendix). Following Proposition 1, the economic interpretations of those results will be stated.

Proposition 2. If a developing country promotes a FTZ through the reduction of the tariff on imported intermediate goods in area 2, the output in the sub-urban sector and in the agricultural sector decreases, and the output in the free-trade zone increases.

The above result can be explained as follows. If a reduction of tariff on imported intermediate goods is carried out, foreign firms in the FTZ use more imported intermediate goods. Consequently, the demand of labor increases in the FTZ. The tariff reduction on imported intermediate goods raises the wage in area 2, W_g, and it means that the expected wage in the urban modern sector relatively decreases. The rise in the wage leads unemployed unskilled labor in the urban modern sector to go back their home, namely, area 2. The labor come back from area 1 and a part of labor in the agricultural sector are absorbed into the FTZ. Therefore the output in the FTZ increases and output in the agricultural sector decreases. The level of urban unskilled unemployment declines. On the other hand, the tariff reduction on imported intermediate goods affects the labor movement in area 1 through a rise in the price of the intermediate goods that are produced in the agricultural sector. Because of the rise in the price of the domestically produced intermediate goods, the wage in the sub-urban sector, W_A, decreases. The decrease in the wage, W_A, means that the expected wage in the urban modern sector relatively rises. Consequently, labor in the sub-urban sector try to move to the urban modern sector, and the output in the sub-urban sector decreases. However, because the tariff reduction on imported intermediate goods dose not affect the

urban modern sector, the amount of labor employed in the urban modern sector is kept constant. Thus the labor attempting to move from the sub-urban sector to the urban modern sector is absorbed into the pool of the unemployed, and the level of urban skilled unemployment rises.

4. The effects on welfare

We have already examined the effects of promoting a FTZ on employment and output in the former section. In this model, it was not clear whether unemployment will increase or decrease. Then, can our model support the host countries' expectation that national income increases? In order to address this question, in our two-area model, we examine the effect of the tariff reduction on income in each area separately, and then the effect on aggregate income is checked. First, let us note on the welfare measures in area 1 and area 2.

The income in area 1 equals payments to domestic factors. Thus we can express the welfare in area 1, Y_1, as

$$\begin{aligned} Y_1 &= \overline{W}L_M + \overline{W_u}L_u + W_A L_A + \overline{K}R \\ &= W_A\overline{L_s} + \overline{W_u}L_u + \overline{K}R \end{aligned} \tag{17}$$

where L_M, L_u, L_A are the quantity of skilled labor and unskilled labor employed in the urban modern sector and of labor in the sub-urban sector respectively. Because the rental to foreign capital, r^*, is fully repatriated abroad, area 2 acquires payment to domestic factor, labor, and tariff revenue. However, the tariff revenue is not counted among payments in area 2.[10] The welfare in area 2, Y_2, therefore, is

$$\begin{aligned} Y_2 &= W_g(L_g + L_f) \\ &= W_g(\overline{L_i} - L_u - u) \end{aligned} \tag{18}$$

where L_f, L_g are the quantity of labor employed in the free-trade zone and the agricultural sector respectively.

Differentiating (14), (15) with respect to t,

$$\begin{aligned} dY_1/dt &= \overline{L_s}(dW_A/dt) + \overline{W_u}(dL_u/dt) + \overline{K}(dR/dt) \\ &= \overline{L_s}(dW_A/dt)(>0) \end{aligned} \tag{19}$$

$$\begin{aligned} dY_2/dt &= (\overline{L_i} - L_u - u)(dW_g/dt) - W_g(du/dt) \\ &= \overline{L_i}(dW_g/dt)(<0) \end{aligned} \tag{20}$$

10) When national income is calculated, the tariff revenue should be included.1

We already obtain $dW_g/dt < 0$, $dW_A/dt > 0$, $dR/dt = 0$ (see Appendix). Therefore we get the results that $dY_1/dt > 0$ and $dY_2/dt < 0$.

Proposition 3. If developing countries lower a tariff on imported intermediate goods in the free-trade zone to attract more foreign direct investment, then, the income in area 1 decreases and in area 2 increases.

The economic interpretation is as follows. A reduction in the tariff on intermediate goods dose not affect the return to capital specific to the urban modern sector ($dR/dt = 0$). On the other hand, the return to foreign capital, r^*, is fully repatriated. Thus the change of the income in area 1 and 2 is measured with the change of labor's earnings. At constant output price in the FTZ, the tariff reduction raises the wage in area 2 ($dW_g/dt < 0$). On the other, it makes the wage lower in the sub-urban sector through a rise in the price of domestically produced intermediate goods ($dW_A/dt > 0$). Therefore the income in area 1 decreases and in area 2 increases.

Next, we examine the effect on national welfare. In this model, the national welfare consists of the income in area 1, 2 and the tariff revenue on an imported intermediate good. Thus the national welfare is expressed as follows.

$$\begin{aligned} Y &= Y_1 + Y_2 + tG \\ &= \overline{W}L_M + \overline{W}_u L_u + W_A L_A + \overline{K}R + W_g(L_g + L_f) + tG \end{aligned} \tag{21}$$

where G denotes the demands for the imported intermediate goods in the free-trade zone ($G = C_P^f X_f$). Differentiating (18) with respect to t yields

$$\begin{aligned} dY/dt &= dY_1/dt + dY_2/dt + d(tG)/dt \\ &= dY_1/dt + dY_2/dt + D \\ &= \overline{L_s}(dW_A/dt) + \overline{L_i}(dW_g/dt) + \overline{K}(dR/dt) + D \end{aligned} \tag{22}$$

where $D = G + t(dG/dt)$. We have already shown that $dW_A/dt > 0$, $dW_g/dt < 0$ and $dR/dt = 0$. Moreover, we obtain $dG/dt < 0$ (see Appendix). Thus the sign of D depends on the loss in revenue at the initial value of imports and the volume of trade effect. In the case of $D < 0$, if $\overline{L_s} < \overline{L_i}$ and $|dW_A/dt| < |dW_g/dt|$, then we get $dY/dt < 0$. On the other hand, in $D > 0$, if $\overline{L_s} > \overline{L_i}$ and $|dW_A/dt| > |dW_g/dt|$, we get $dY/dt > 0$.

Proposition 4. (1) In a developing country where $\overline{L_s} < \overline{L_i}$, if policy makers carry out a reduction in the tariff on imported intermediate goods to promote a free-trade zone and

the tariff reduction makes tariff revenue rise and the change of the wage in area 2 bigger than in the sub-urban sector, then national income will increase.

(2) In a developing country where $\overline{L_s} > \overline{L_i}$, if a tariff reduction to promote a free-trade zone makes tariff revenue fall and the change of the wage in the sub-urban sector bigger than in area 2, then national income will decrease.

5. Conclusion

We have analyzed a two-area model that consists of four sectors, namely, the urban modern sector, the sub-urban sector, the agricultural sector and the free-trade zone. The results may give developing countries an adequate incentive to promote FTZs in the rural area.

Our two-area model gives us the interesting results: even if the tariff reduction in the free-trade zone increases or decreases national income, the rural area which accommodates a FTZ always benefits from it, and the effect of the tariff reduction on national income depends heavily on the amount of skilled labor and unskilled labor.

On the other hand, the tariff reduction generates the possibility of increasing urban unemployment. Thus, the promotion of a FTZ in the rural area is the means of developing the poor rural area at the cost of the developing urban area. However, it does not always decrease aggregated income.

Finally, it is also important to consider the case that a FTZ is located in the urban area. If a common motive for setting up a FTZ is high domestic unemployment as Young and Miyagiwa (1987) remarked, establishing a FTZ in the urban area may be better than in the rural area.

Appendix

(1) The effects of a change of t on the exogenous valuables

Totally differentiating equations (2)-(4), We have:

$$C_W^A dW_A + C_P^A dP_g = 0 \tag{A1}$$

$$C_W^f dW_g + C_P^f dt = 0 \tag{A2}$$

$$C_W^g dW_g = dP_g \tag{A3}$$

Thus we obtain:

$$dW_g/dt = -C_P^f/C_W^f < 0 \tag{A4}$$

$$dP_g/dW_g = C_W^g > 0 \tag{A5}$$

$$dW_g/dP_g = -C_P^A/C_W^A < 0 \tag{A6}$$

Using (A4) - (A6), we get the effects of a change of t on the exogenous valuables, P_g and W_A, as follows.

$$dP_g/dt = (dP_g/dW_g)(dW_g/dt) < 0 \quad \text{(A7)}$$

$$dW_A/dt = (dW_A/dP_g)(dP_g/dW_g)(dW_g/dt) > 0 \quad \text{(A8)}$$

(2) The effects of a change of t on outputs

We now show that $dC_W^A/dt \leq 0$, $dC_W^f/dt \geq 0$, $dC_W^g \geq 0$, $dC_P^A/dt \geq 0$.

$$dC_W^A/dt = C_{WW}^A(dW_A/dt) + C_{WP}^A(dP_g/dt) \quad \text{(A10)}$$

$$dC_W^f/dt = C_{WW}^f(dW_g/dt) + C_{WP}^f \quad \text{(A11)}$$

$$dC_W^g/dt = C_{WW}^g(dW_g/dt) \quad \text{(A12)}$$

$$dC_P^A/dt = C_{PW}^A(dW_A/dt) + C_{PP}^A(dP_g/dt) \quad \text{(A13)}$$

where $dW_A/dt > 0$, $dP_g/dt < 0$ and $dW_g/dt < 0$. From one of the properties of unit cost function, for $C_{jk}(j, k = W, R, P)$, if $j = k$, we obtain $C_{jk} \leq 0$. If $j \neq k$, $C_{jk} \geq 0$ can be obtained. Therefore we can show that $dC_W^A/dt \leq 0$, $dC_W^f/dt \geq 0$, $dC_W^g/dt \geq 0$, $dC_P^A/dt \geq 0$.

References

Chaudhuri, T.D. and Adhikari, S., "Free trade zones with Harris-Todaro unemployment - A note on Young-Miyagiwa -," *Journal of Development Economics 41*, 1993, 157-162.

Corden, W.M. and Findlay, R., "Urban unemployment, intersectoral capital mobility and development policy," *Economica 29*, 1975, 59-78.

Din, M., "International capital mobility and development policy in a dual economy," *Review of International Economics 4*, 1996, 185-201.

Din, M., "Export processing zones and backward linkages," *Journal of Development Economics 43*, 1994, 369-385.

Hamada, K., "An economic analysis of the duty-free zone," *Journal of International Economics 4*, 1974, 225-241.

Hamilton, C. and Svensson, L., "On the welfare effects of a 'duty free' zone," *Journal of*

International Economics 13, 1982, 45-64.

Harris, J.R. and Todaro, M., "Migration, unemployment and development: A two sector analysis," *American Economic Review 60*, 1970, 126-142.

Miyagiwa, K., "A reconsideration of the welfare economics of a free-trade zone," *Journal of International Economics 21*, 1986, 337-350.

Miyagiwa, K., "The locational choice for free-trade zones - Rural versus urban options -," *Journal of Development Economics 40*, 1993, 187-203.

Rodriguez, C.A., "A note on the economics of the duty free zone," *Journal of International Economics 6*, 1976, 385-388.

Young, L., "Intermediate goods and the formation of duty-free zones," *Journal of Development Economics 25*, 1987, 369-384.

Young, L. and Miyagiwa, K., "Unemployment and the formation of duty-free zones," *Journal of Development Economics 26*, 1987, 397-40