

Research Note

ADJUSTMENT TO IMPORT COMPETITION

— **The Small Open Economy with Downward Wage Rigidity*** —

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I. Introduction

Adjustment of an economy is the process of movement of factors of production from the declining sector to the growing sector, accompanied by changes in factor prices. Adjustment is constantly necessitated by the incessant change in the structure of international specialization which takes form of import competition to the domestic industries.

Adjustment is costly in that it is time and efficiency consuming, depending on the natures of the factor markets. Costless adjustment can only take place if factors can instantaneously move between sectors and factor prices can instantaneously change. Such a behaviour of the factor markets are often considered to be that occurring in the long-run (a Heckscher-Ohlin-Samuelson model assumption). Sector specificities (immobilities) of factors, losses of efficiencies of factors upon movement, and rigidities and stickinesses of factor prices are considered to occur in the shorter-run periods.

Adjustment to import competition has become a problem for the developed economies. This may be due to the economic slow down (the pie is no longer increasing by much and there are no rapidly growing industries to quickly absorb the frictionally unemployed factors of production), and the increased speed of transfer of technology (innovative industries are very quickly challenged by the late-comer foreign competitors). This has lead policy makers into the free trade versus protection controversy. Thus what we need now is the development in the theories of the adjustment process in order to determine suitable policies, both domestic and international. This paper is one such attempt.

We consider a small open economy with two sectors and two factors of production (labour and capital). We impose a constraint of downward wage rigidity in the labour market, to persist even in the long-run.⁽¹⁾ In the capital market, sector specificity of capital is imposed to hold in the short-run; and capital to gradually move in the following time period.⁽²⁾ Import competition is considered as the fall in the relative price of the relatively labour-intensive import good. The resulting equilibrium under sector specificity of capital is called the short-run equilibrium.⁽³⁾ The period that follows in which capital moves is considered the adjustment phase. When capital movement is complete we reach the long-run equilibrium.

This is unlike the assumption in most literature in which labour market is assumed to adjust before or simultaneously with the capital market. When factor mobilities are compared, it may be reasonable to assume that labour mobility is greater than capital mobility. However, when fall in wage rate is compared with capital mobility, the latter to precede the former is reasonable.

II. Model

Production functions, defined as follows, are of standard neo-classical constant returns to scale type. X and Y are quantities produced, L_i and K_i ($i = X, Y$) are factor inputs to each sector, and X_L , etc. represent the partial derivatives with respect to the subscripts.

$$X = X(L_X, K_X); X_L, X_K > 0, X_{LL}, X_{KK} < 0, X_{LK} = X_{KL} > 0 \quad (1)$$

$$Y = Y(L_Y, K_Y); Y_L, Y_K > 0, Y_{LL}, Y_{KK} < 0, Y_{LK} = Y_{KL} > 0 \quad (2)$$

a_{ji} ($i = X, Y; j = L, K$) represent factor inputs for one unit production:

$$a_{LX}X = L_X \quad (3)$$

$$a_{LY}Y = L_Y \quad (4)$$

$$a_{KX}X = K_X \quad (5)$$

$$a_{KY}Y = K_Y \quad (6)$$

Labour supply (L) is exogenously given. Since labour demand ($L_X + L_Y$) may fall short of supply because of the downward rigidity, the difference is defined to be unemployment (L_U):

$$L = L_X + L_Y + L_U \quad (7)$$

Capital supply (K) is also exogenously given, and is assumed to be always fully utilized. The initial allocation among the two sectors is that to equalize the rentals in each sector.

$$K = K_X + K_Y \quad (8)$$

Sector X is assumed to be relatively labour-intensive by the physical definition.

$$\lambda = \lambda_{LX}\lambda_{KY} - \lambda_{KX}\lambda_{LY} > 0 \text{ where } \lambda_{Li} = L_i/L, \lambda_{Ki} = K_i/K$$

Conditions for cost minimization in the two sectors are:

$$-\frac{dK_X}{dL_X} = -\frac{da_{KX}}{da_{LX}} = \frac{X_L}{X_K} = \frac{w}{r_X} \quad (9)$$

$$-\frac{dK_Y}{dL_Y} = -\frac{da_{KY}}{da_{LY}} = \frac{Y_L}{Y_K} = \frac{w}{r_Y} \quad (10)$$

w represents the wage rate (in terms of units of good Y) common to both sectors and is at the wage floor of value w^0 . w^0 is the wage rate at the initial equilibrium at which there is no unemployment. r_i represent the rental (in terms of units of good Y) for sector i . Profit maximization for competitive firms assures:

$$a_{LX}w + a_{KX}r_X = p \quad (11)$$

$$a_{LY}w + a_{KY}r_Y = 1 \quad (12)$$

p represents the price of good X in terms of units of good Y.

Equations (1) to (12) solve for the twelve endogenous variables of $X, Y, a_{ji}, L_i, L_U, K_Y$ and r_i . The exogenous variables are L, K, K_X, w and p .

III. Initial Equilibrium

The initial equilibrium is when both factor markets are in equilibrium (full employment of factors and equality of factor prices among sectors).⁽⁴⁾

In this model, this is when $L_U = 0$ and $r_X = r_Y$.

In Figure 1,⁽⁵⁾ Panel (i) shows the labour market, with horizontal axis representing units of labour ($O_X O_Y = L$) and vertical axis representing w . O_i is the origin for sector i . Curves V_{LX}^0 and V_{LY}^0 are initial positions of the value marginal product of labour schedules of the two sectors. Their intersection, A , is the initial labour market equilibrium point. This shows that initially, $w = w^0$, $L_X = O_X L_0$, $L_Y = O_Y L_0$ and $L_U = 0$.

Panel (iv) shows the capital market in a similar manner. a' is the initial capital market equilibrium point, whereby $r_X = r_Y = r^0$, $K_X = o'_X K_0$ and $K_Y = o'_Y K_0$.

Panel (ii) shows the factor price frontiers for the two sectors, initially curves c_X^0 and c_Y , intersecting at point A' with $w = w^0$ and $r_X = r_Y = r^0$.

Panel (iii) is the standard box diagram, labour measured horizontally and capital measured vertically. o_i is the origin for sector i . Curve $o_X o_Y$ is the efficiency locus. The initial equilibrium point is a .

Figure 2 is the product transformation plane. $T_1 T_2$ is the transformation curve of the Heckscher-Ohlin-Samuelson economy, corresponding to the efficiency locus $o_X o_Y$ in Figure 1 Panel (iii). Point A'' indicates the initial production, with initial relative price represented by slope of line P_0 .

IV. Effect of Import Competition in the Short-Run

For the downward wage rigid economy, the short-run is defined as the period in which capital remains sector specific. Import competition is defined as the ceteris paribus once-and-for-all fall in p (relative price of good X to Y). The short-run effects of import competition can be determined by differentiating equations (1) to (12) and substituting

$\hat{p} < 0$ and $\hat{L} = \hat{K} = \hat{K}_X = \hat{w} = 0$ ⁽⁶⁾ (a hat over a variable indicates its fractional change i.e. $\hat{x} = dx/x$).

$$\hat{X} = \frac{\theta_{LX}\sigma_X}{\theta_{KX}} \hat{p} < 0 \quad (13)$$

$$\hat{Y} = 0 \quad (14)$$

$$\hat{L}_X = \frac{\sigma_X}{\theta_{KX}} \hat{p} < 0 \quad (15)$$

$$\hat{L}_Y = 0 \quad (16)$$

$$\hat{L}_U = -\frac{\lambda_{LX}\sigma_X}{\lambda_{LU}\theta_{KX}} \hat{p} > 0 \quad (17)$$

$$\hat{K}_Y = 0 \quad (18)$$

$$\hat{a}_{LX} = \sigma_X \hat{p} < 0 \quad (19)$$

$$\hat{a}_{LY} = 0 \quad (20)$$

$$\hat{a}_{KX} = -\frac{\theta_{LX}\sigma_X}{\theta_{KX}} \hat{p} > 0 \quad (21)$$

$$\hat{a}_{KY} = 0 \quad (22)$$

$$\hat{r}_X = \frac{1}{\theta_{KX}} \hat{p} < 0 \quad (23)$$

$$\hat{r}_Y = 0 \quad (24)$$

$$\theta_{Li} = wa_{Li}/p_i, \theta_{Ki} = r_i a_{Ki}/p_i, p_X = p, p_Y = 1;$$

$$\lambda_{LU} = L_U/L; \sigma_i = (a_{Ki}/a_{Li})/(w/r_i)$$

These indicate the directions of changes of the endogenous variables.

These changes can also be observed in Figure 1 where the short-run equilibrium points are indicated by points E, E', e and e' for sector X; and A, A', a and a' for sector Y.

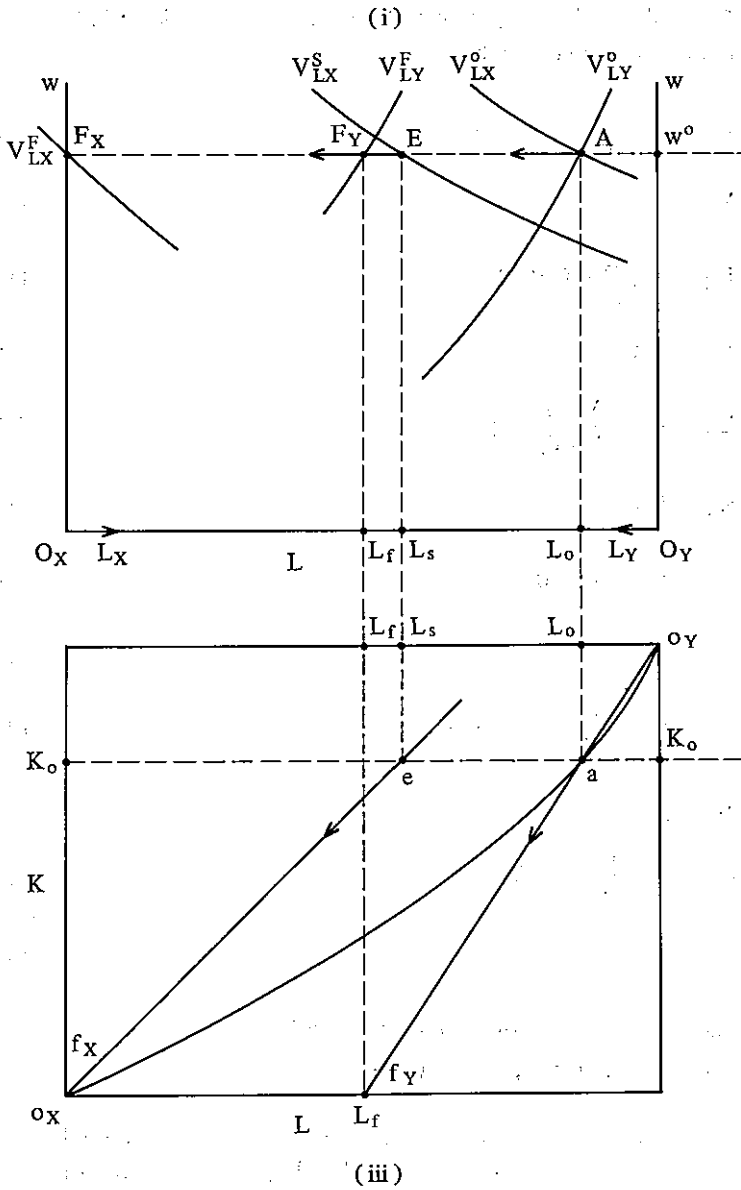
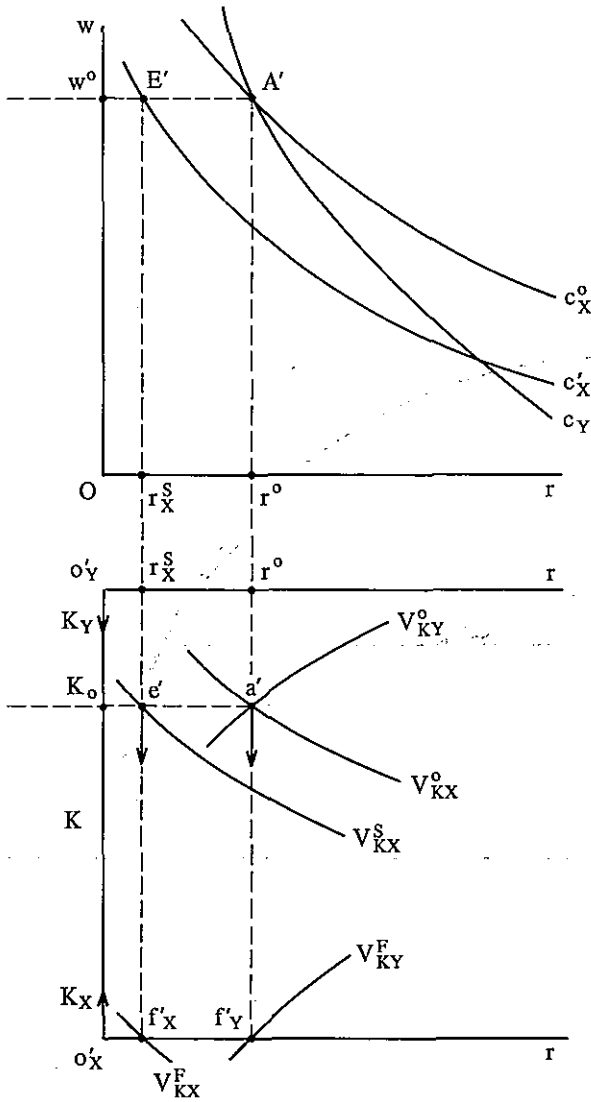


Figure 1

(ii)



(iv)

Figure 1

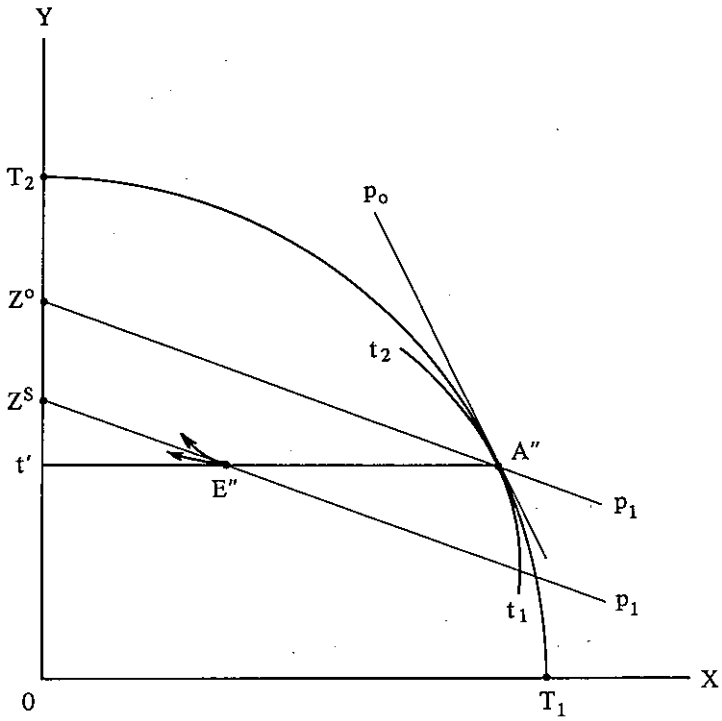


Figure 2

On Panel (i), curve V_{LX}^0 shifts to V_{LX}^s , while curve V_{LY}^0 is unaffected. Since wage rate is downward rigid and stays at w^0 , the short-run equilibrium points are E and A for sectors X and Y respectively. L_X decreases from $O_X L_0$ to $O_X L_s$, while L_Y remains at $O_Y L_0$, creating L_U of $L_s L_0$.

On Panel (iv), curve V_{KX}^0 shifts to V_{KX}^s , while curve V_{KY}^0 is unaffected. Since capital allocation stays constant at $o'_X K_0$ and $o'_Y K_0$, the short-run equilibrium points are e' and a' for sectors X and Y respectively. r_X falls to r_X^s and r_Y stays at r^0 .

On Panel (ii), curve c_X^0 shifts to c_X^s , while c_Y is unaffected. Since w stays downward rigid at w^0 , r_X falls to r_X^s and r_Y stays at r^0 . Equations (25) and (26) summarises the effect to factor prices in terms of units of good Y and in terms of units of good X respectively:

$$\hat{r}_Y = \hat{w} = 0 > \hat{p} > \hat{r}_X \quad (25)$$

$$\hat{r}_Y - \hat{p} = \hat{w} - \hat{p} > -\hat{p} > 0 > \hat{r}_X - \hat{p} \quad (26)$$

On Panel (iii), the short-run factor allocation becomes to be at points e and a for sectors X and Y respectively. Production is now inefficient, with unemployed labour of $L_s L_0$. Compared to the initial allocation, sector X employs less labour with the same capital, so production of X decreases (point e is on a lower isoquant – not shown). Sector Y employs the same amount of inputs, so production of Y stays the same.

In Figure 2, $t'A''t_1$ is the short-run transformation curve for this downward wage rigid economy. $A''t_1$ is the portion for rises in p in which the wage constraint does not come in and the economy is only constrained by sector specificity of capital.⁽⁷⁾ The short-run equilibrium point is E'' on the flat portion $t'A''$, where X has decreased while Y has remained constant.

We define national product (Z) in terms of units of good Y as:

$$Z = pX + Y \quad (27)$$

Valued by p after the import competition (represented by the slope of

line p_1), national product at the initial equilibrium is OZ^0 . Effect of import competition on Z is:

$$\hat{Z} = \rho_X \left(\frac{\theta_{LX} \sigma_X}{\theta_{KX}} + 1 \right) \hat{p} < 0 \quad (28)$$

where $\rho_X = pX/Z$ ($\rho_Y = Y/Z$).

Z decreases in the short-run upon import competition. The larger the values of ρ_X , θ_{LX} and σ_X are, and the smaller the value of θ_{KX} is, the larger the extent of decrease in Z . In Figure 2, Z falls to OZ^s .

V. Adjustment from the Short-Run to the Long-Run Equilibrium

At the above short-run equilibrium, there exist unemployment in the labour market and sectoral rental differential in the capital market. Adjustment for the downward wage rigid economy is by capital moving from the lower rental to the higher rental sector (from sector X to Y). The effects of adjustment can be determined by differentiating equations (1) to (12) and substituting $\hat{K}_X < 0$ and $\hat{L} = \hat{K} = \hat{w} = \hat{p} = 0$.⁽⁸⁾

$$\hat{X} = \hat{K}_X < 0 \quad (29)$$

$$\hat{Y} = -\frac{\lambda_{KX}}{\lambda_{KY}} \hat{K}_X > 0 \quad (30)$$

$$\hat{L}_X = \hat{K}_X < 0 \quad (31)$$

$$\hat{L}_Y = -\frac{\lambda_{KX}}{\lambda_{KY}} \hat{K}_X > 0 \quad (32)$$

$$\hat{L}_U = -\left(\frac{\lambda_{LX}}{\lambda_{LU}} - \frac{\lambda_{LY} \lambda_{KX}}{\lambda_{LU} \lambda_{KY}} \right) \hat{K}_X = -\frac{\lambda}{\lambda_{LU} \lambda_{KY}} \hat{K}_X > 0 \quad (33)$$

$$\hat{K}_Y = -\frac{\lambda_{KX}}{\lambda_{KY}} \hat{K}_X > 0 \quad (34)$$

$$\hat{a}_{LX} = 0 \quad (35)$$

$$\hat{a}_{LY} = 0 \quad (36)$$

$$\hat{a}_{KX} = 0 \quad (37)$$

$$\hat{a}_{KY} = 0 \quad (38)$$

$$\hat{f}_X = 0 \quad (39)$$

$$\hat{f}_Y = 0 \quad (40)$$

These effects can be observed geometrically in Figure 1 in which the adjustment paths from the short-run equilibrium points are indicated by the arrows. The long-run equilibrium points are F_X , F_Y , E' , A' , f_X , f_Y , f'_X and f'_Y in each of the panels.

On Panel (ii), since p is constant during adjustment, the factor price frontiers stay at c'_X and c_Y . Since w is downward rigid at w^0 , the rentals for the two sectors are constantly $r_Y = r^0 > r_X = r^s_X$ during adjustment. Sectors X and Y are constantly at points E' and A' respectively, and factor intensities (slopes of the factor price frontiers at these points) remain constant. The most notable result here is that the rental differential ($r_Y > r_X$) stays constant during adjustment in spite of the movement of capital from sector X to Y . This implies that the capital movement will not cease until all of sector X 's capital have moved to sector Y . The long-run equilibrium is that of complete specialization in Y .

On Panel (i), by this adjustment, V^s_{LX} and V^0_{LY} move successively towards V^F_{LX} and V^F_{LY} respectively, while w stays constant. At the long-run equilibrium points F_X and F_Y , $L_X = 0$ and $L_Y = O_Y L_f$. L_U increases successively from $L_s L_o$ to $O_X L_f$, creating an ever large unemployment.

On panel (iv), the successive decrease in L_X and increase in L_Y shift V^s_{KX} and V^0_{KY} successively towards V^F_{KX} and V^F_{KY} respectively. At the long-run equilibrium points f'_X and f'_Y , rentals are unchanged, $K_X = 0$ and $K_Y = K$.

On panel (iii), adjustment successively moves the capital allocation line K_0K_0 down. Since factor intensities stay constant, factor allocation points move successively down from e towards f_X along ray o_Xe for sector X, and from a towards f_Y along ray o_Yf_Y for sector Y. Production of X decreases successively to 0 and production of Y increases successively. Since sector X is relatively labour-intensive, and factor intensities stay constant, the effect of movement of capital is to displace more labour from sector X than sector Y newly employs. Thus unemployment increases.

The effect on national product is:

$$\dot{Z} = (\rho_X - \rho_Y \frac{\lambda_{KX}}{\lambda_{KY}}) K_X \quad (41)$$

When $\rho_X < \rho_Y \lambda_{KX} / \lambda_{KY}$ (or $pX/Y < K_X / K_Y$), $\dot{Z} > 0$. When $\rho_X > \rho_Y \lambda_{KX} / \lambda_{KY}$ (or $pX/Y > K_X / K_Y$), $\dot{Z} < 0$, indicating immiserizing reallocation⁽⁹⁾ when the movement of capital from the lower to the higher rental sector is what seems to raise efficiency. Immiserizing reallocation occurs, the larger the sector X's share in national income is, and the less the sector X's share of capital is. This is because increase in unemployment is large under these conditions. National product may rise or fall during adjustment and in sum at the long-run equilibrium. Thus in Figure 2, the adjustment path from the short-run equilibrium point E'' is indicated to be indeterminate, and the long-run equilibrium point may come above or below Z^S . What is sure is that adjustment path is always in the north-west direction since X is constantly decreasing and Y is constantly increasing, and long-run equilibrium is on the Y axis (between points t' and T_2) indicating complete specialization in Y (with unemployment).

VI. Conclusion

For such economy with downward wage rigidity, import competition (although it is an improvement in the terms of trade) creates unemployment and lowers national product in the short-run when capital remains sector specific. As the economy adjusts toward the long-run equilibrium

(complete specialization) by capital moving from the lower rental to the higher rental sector, unemployment increases and national product may decrease (the case of immiserizing reallocation). The resulting long-run equilibrium is far from the equilibrium the Heckscher-Ohlin-Samuelson model would predict.

What has been clarified is that, downward wage rigidity acts as a very large obstacle against adjustment, calling for policies. The first-best policy is to remove or directly counter the downward wage rigidity constraint. One possibility is a dynamic wage subsidy scheme that keeps in pace with capital movement ensuring full employment at any stage of the adjustment process. However, this scheme needs to be financed by a large lump sum tax which is unrealistic.

If unemployment is a concern for the government, if adjustment is slow and immiserizing, or if national product in the long-run is lower than that of the initial equilibrium (especially if adjustment in sum is immiserizing), and if no other policy measures are suitable, protection will be justified. (Policies to speed adjustment will speed the increase in unemployment.) Protection will enable the economy to decrease unemployment (to zero) and recover its original national product.

Notes

* This paper is a revision of Chapters 5 and 7 of the author's Master's thesis, "Adjustment to Import Competition: the Case For a Small Open Economy," International Christian University, 1988. The author is deeply indebted and grateful to Professors Kiyoshi Kojima and Tsuneo Nakauchi for their guidance and supervision. The author is much thankful to Professors Shigeru Ishiwata and Kenji Kimura. Any errors and shortcomings are the sole responsibility of the author.

- (1) This is identical to the wage floor.
- (2) Here, a physical constraint is assumed in the capital market, whilst a price constraint is assumed in the labour market.
- (3) This short-run equilibrium of the downward wage rigid economy is identical to the "ultra-short-run" equilibrium in Neary [1982].
- (4) This is a Heckscher-Ohlin-Samuelson equilibrium.

- (5) The geometric technique follows that in Neary [1978].
- (6) By constraining wage rate in terms of units of good Y to be constant, the fall in the relative price of X raises the wage rate in terms of units of good X. This is seen in equation (26). Thus the real incomes of wage earners rise upon import competition if any of good X is consumed.
- (7) Curve $t_1 t_2$ is the transformation curve of the economy constrained only by sector specificity of capital. (see Mayer [1974])
- (8) Since the fall in the relative price of X is once-and-for-all, during adjustment, wage rate in terms of units of either good remains downward rigid.
- (9) This is a special case of Neary's immiserizing reallocation in Neary [1982].

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輸入競争に対する調整

——小国開放経済における賃金下方硬直性のケース——

〈要 約〉

金 田 充 弘

輸入競争とは輸入財の相対価格下落によって表される国内産業への競争である。要素価格の変化につれ国内競争産業（輸入部門）から輸出部門へ生産要素が移動しなければならない。要素価格の瞬間的な変化、および生産要素の瞬間的かつ効率性をなくすことのない移動とがないかぎり調整は動学的なコストを伴う。国際分業構造の変化の速度は時代とともに早まっており、特に成長が鈍化している経済にとっては、輸入競争に対する調整がますます困難な問題となってきた。

本稿では賃金が下方硬直的である小国経済において、資本が短期的に部門間不移動的であり、調整期間（短期均衡と長期均衡の間）に資本が部門間移動を行うケースを取り扱う。二財（労働集約的輸入競争部門と資本集約的輸出部門）二要素（労働と資本）の生産側モデルであり、生産関数は一次同次とする。初期均衡においては両要素は完全雇用され、均一要素価格（部門間）であるとする。輸入競争（輸入財の相対価格の下落）に対して資本が部門間移動をしない時の均衡を短期均衡とするが、そこでは失業（労働）が生じ、国民生産は低下する。また、輸入競争部門の資本レンタルが下落し、輸出部門との間にレンタル格差が生ずる。この格差に従って資本が輸入競争部門から輸出部門へ移動する（調整）。調整期間において失業は増大し、国民生産は増加も減少もする。レンタル格差は縮まらないので資本がすべて移動するまで調整は続き、調整後の長期均衡は輸出部門による完全特化に陥る。

明確になった点は賃金下方硬直性が調整に際して大きな障害になり得ること、従って政策による介入を要するということである。賃金下方硬直性に直接対抗する政策がとれない場合には失業が発生する。到達できる長期均衡においても国民生産は初期均衡値より減少する。それ故保護は正当化される。