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OPTIMAL COMMERCIAL POLICY FOR A MINIMUM-WAGE ECONOMY

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INTRODUCTION

The standard Heckscher-Ohlin analysis of an open economy has been extended to consider the welfare implications of various factor-market imperfections. Two such imperfections may be seen as polar types.[1] In one of these cases, there is a distortive wage differential between sectors, with perfect flexibility of the real wage ensuring full employment of labor. In the other case, there is wage equality between sectors, with downward inflexibility of the (uniform) real wage leading to unemployment of labor. For the first case, Bhagwati and Ramaswami (1963) and Bhagwati, Ramaswami and Srinivasan (1969) have established a welfare ranking of alternative commercial policies. The present paper performs a similar type of exercise for the second case, which has been discussed by Haberler (1960), Johnson (1965), Bhagwati (1968) and Brecher (1974).[2]

Part I briefly reviews the model in which the entire labor market is subject to an exogenously specified floor, or minimum, that constrains the real wage to exceed the maximum level consistent with full employment. Within this constrained-wage context, Part II considers various commercial policies of the

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home country (i.e., the minimum-wage country), assuming that this economy has monopoly power in trade and remains incompletely specialized. Three policy combinations are ranked in increasing order of social-welfare optimality, as follows: 1) a trade tax (subsidy) in the absence of complementary commercial intervention; 2) a trade tax (subsidy) together with a consumption tax-cum-subsidy favoring one commodity; and 3) a trade tax together with a factor tax-cum-subsidy favoring the use of labor uniformly in all sectors, which is a first-best policy package. In case some of these taxes and subsidies are unavailable (see below), the discussion has been designed to show how to make the most of whichever ones actually can be used. In proceeding upwards through the policy ranking, there is an increase not only in the maximum achievable level of social welfare, but also in this level's corresponding quantity of overall labor employment.

I. THE MODEL

Section A considers the production side of a minimum-wage economy. Then, home and foreign demand are introduced in Section B, so that the full international equilibrium can be determined in Section C. Finally, Section D derives the consumption-possibility frontier to be used in Part II.

A. Production

Before introducing the wage constraint, recall the standard two-factor, two-good model of trade theory. Two commodities (one and two) are produced in amounts X_1 and X_2, using L_1 and L_2 units of labor plus K_1 and K_2 units of capital, with strictly concave production functions exhibiting homogeneity of degree one:

$$X_i = F_i(K_i, L_i) = L_i f_i(k_i) \qquad i \equiv 1,2 \qquad \ldots (1)$$

where $k_i \equiv K_i/L_i$ and $f_i \equiv F_i/L_i$. The economy is endowed with fixed, overall factor supplies ($\bar{L}$ and $\bar{K}$), which constrain the total employment levels (L and K):

$$L \equiv L_1 + L_2 \leqq \bar{L} \qquad \ldots (2)$$

$$K \equiv K_1 + K_2 \leqq \bar{K} \qquad \ldots (3)$$

Both factors are perfectly mobile domestically. Entrepreneurs maximize profits under perfect competition. In addition, it will be assumed throughout this paper that home production remains incompletely specialized at all times.

Now subject the entire labor market to a wage floor, which is exogenously given in real[3] terms. Let this minimum real wage be set by some institutional arrangement (such as custom, unions or law), and be specified in terms of the second[4] good at some fixed[5] level denoted by $\bar{w}_2$. This minimum-wage constraint can be written as

$$w_2 \geqq \bar{w}_2 \qquad \ldots (4)$$

where w_2 is the economy's (uniform) wage in terms of good two, and (by profit maximization) equals MPL_2 which is the economy's (uniform) marginal product of labor in terms of good two. Because of this wage floor, labor may be unemployed. However, since the reward of capital is perfectly flexible, capital must be fully utilized. Thus,

$$\bar{K} = K \equiv L_1 k_1 + L_2 k_2 \qquad \ldots (5)$$

Figure 1 illustrates the familiar relationships between w_2 and k_2 (in the second quadrant) and between k_i ($i = 1, 2$) and ω (in the first quadrant), where

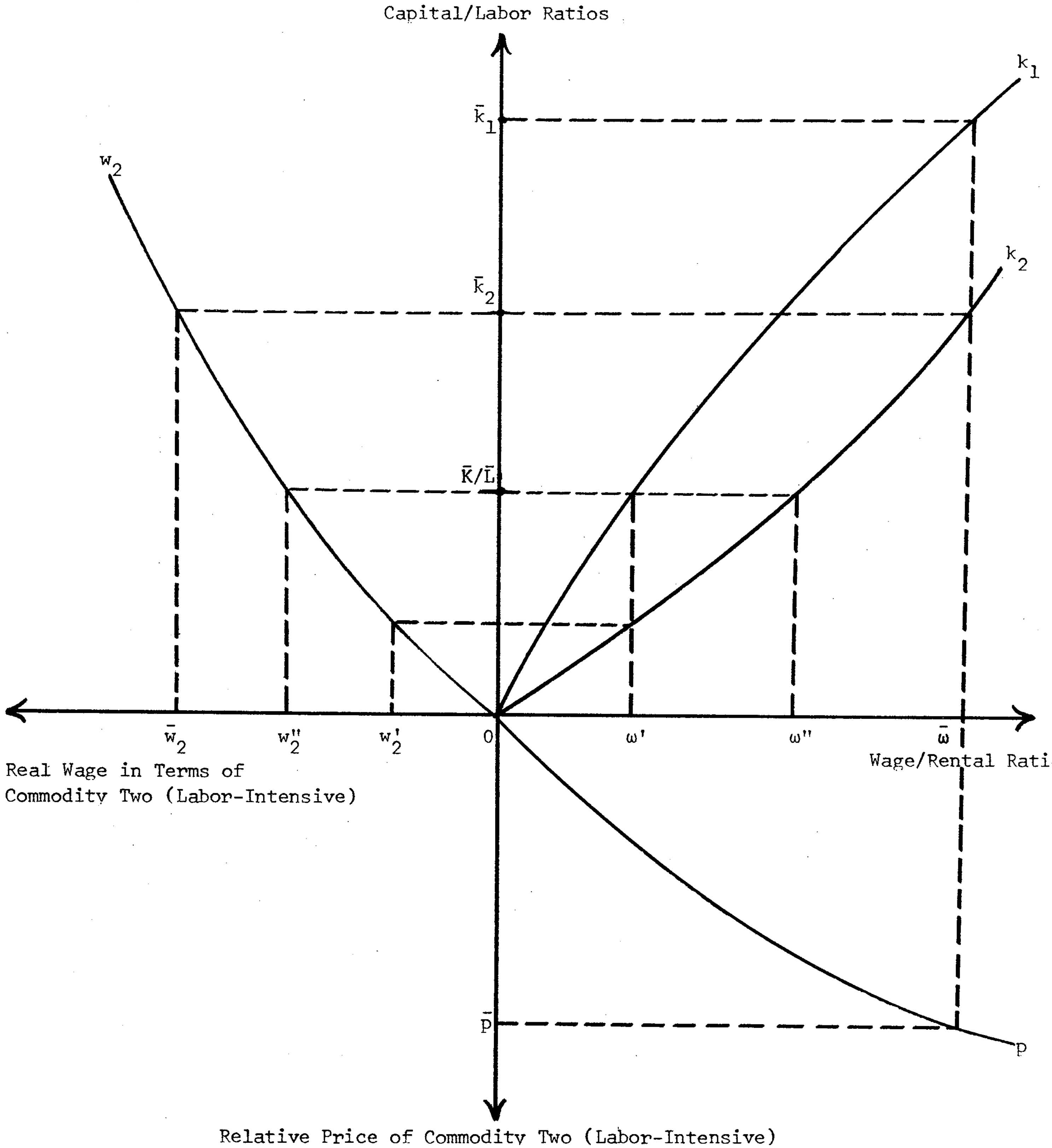
Capital/Labor Ratios
k_1
$\bar{k}_1$
w_2
k_2
$\bar{k}_2$
$\bar{K}/\bar{L}$
$\bar{w}_2$
w_2''
w_2'
0
ω'
ω''
$\bar{\omega}$
Real Wage in Terms of
Commodity Two (Labor-Intensive)
Wage/Rental Ratio
$\bar{p}$
p
Relative Price of Commodity Two (Labor-Intensive)

Figure 1

ω denotes the economy's (uniform) wage/rental ratio.[6] It is well known that, given endowment ratio $\bar{K}/\bar{L}$, full employment of both factors is consistent only with $\omega' \leqq \omega \leqq \omega''$,[7] and hence only with $w_2' \leqq w_2 \leqq w_2''$. However, constraint (4) implies $w_2 > w_2''$, since $\bar{w}_2 > w_2''$ by assumption. In this case, unemployment of labor is necessary, since $\bar{w}_2$ has been specified to exceed the maximum w_2 (and MPL_2) consistent with full employment. This unemployment of labor implies that constraint (4) is binding, with $w_2 = \bar{w}_2$ and hence with $\omega = \bar{\omega}$. This binding case is the interesting one, and the only case considered in this paper.

Figure 1 also shows the well-known Samuelson (1949) relationship between ω and p (in the fourth quadrant), where p is the relative price of the second good in terms of the first. The equilibrium wage/rental ratio ($\bar{\omega}$) corresponds to the equilibrium values $\bar{p}$, $\bar{k}_1$ and $\bar{k}_2$. Since $\bar{k}_1 > \bar{k}_2$, good one (two) is relatively capital-intensive (labor-intensive) in the relevant range.[8] Substituting $\bar{k}_1$ and $\bar{k}_2$ into equations (1) and (5), it follows after simple manipulation that

$$X_1 = \alpha - \beta X_2 \qquad \text{. . . (6)}$$

where α and β are constants defined as $\alpha \equiv \bar{K}f_1(\bar{k}_1)/\bar{k}_1$ and $\beta \equiv \bar{k}_2 f_1(\bar{k}_1)/\bar{k}_1 f_2(\bar{k}_2)$. Equation (6) describes the minimum-wage transformation curve, illustrated by the straight line R_2R_1 in Figure 2. The equilibrium price line (for $\bar{p}$) is flatter than R_2R_1, since $\bar{k}_1 > \bar{k}_2$ implies $\bar{p} > \beta$. [The first-order conditions for profit maximization can be manipulated to yield $\beta = \bar{p}(\bar{\omega}\bar{k}_2 + \bar{k}_1\bar{k}_2)/(\bar{\omega}\bar{k}_1 + \bar{k}_1\bar{k}_2) < \bar{p}$, where β was defined as the ratio of capital's average products,and $\bar{p}$ equals the ratio of capital's (and labor's) marginal products.] As output of the (labor-intensive) second good increases with upward movements along R_2R_1, total employment of labor increases. [That is,

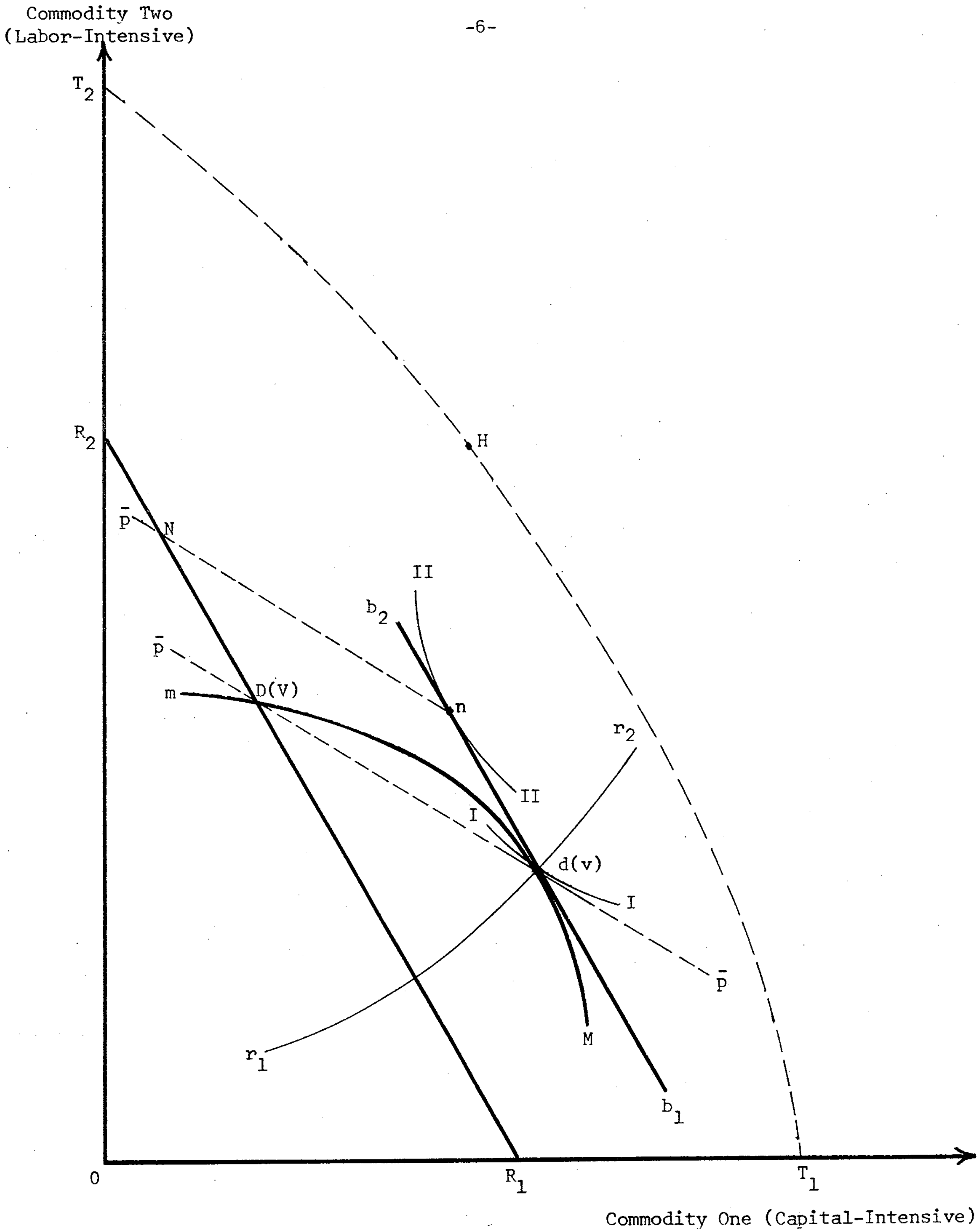
Commodity Two
(Labor-Intensive)
T_2
R_2
H
$\bar{p}$
N
II
b_2
$\bar{p}$
m
D(V)
n
r_2
II
I
d(v)
I
$\bar{p}$
M
r_1
b_1
0
R_1
T_1
Commodity One (Capital-Intensive)

Figure 2

$dL/dX_2 = (\bar{k}_1 - \bar{k}_2)/\bar{k}_1 f_2(\bar{k}_2) > 0$; where equation (5) has been differentiated after substituting from equation (1), using the fact that $L_1 \equiv L - L_2$, and setting $k_i = \bar{k}_i$.] Line R_2R_1 lies completely below the conventional (flexible-wage, full-employment) production-possibility frontier, T_2T_1, to reflect the existence of unemployed labor. The minimum-wage transformation curve,[9] R_2R_1, is a well-known Rybczynski line described by Mundell (1968).

B. Demand

Foreign demand is given by the function $g(E)$; where $g(0) = 0$, $g'(E) \equiv dg/dE > 0$ and $dg'(E)/dE < 0$;[10] and where E denotes foreign net imports (and home net exports) of good two, exchanging for $g(E)$ of foreign net exports (and home net imports) of good one. If $E > (<) \ 0$, in which case $g > (<) \ 0$, the home country exports (imports) the second good and imports (exports) the first good. The function g may be represented in Figure 2 by a conventional foreign offer curve like mDM, whose origin (D) has been placed on the transformation curve (R_2R_1) in the Baldwin (1948) manner.

Home consumption of good i, C_i ($i = 1, 2$), can now be written as

$$C_2 = X_2 - E \qquad \qquad \ldots (7)$$

$$C_1 = \alpha - \beta X_2 + g(E) \qquad \qquad \ldots (8)$$

where use has been made of equation (6). The levels of C_1 and C_2 completely determine social welfare in the traditional way, according to the conventional utility function $U(C_1, C_2)$; where U is a concave function; and the partial derivatives of U, $U_i \equiv \partial U(C_1, C_2)/\partial C_i$ ($i = 1, 2$), are assumed to be positive if C_1 and C_2 are both finite.[11] The function U may be represented by a conventional set of community indifference curves,[12] like I-I and II-II in Figure 2. It is assumed throughout this paper that neither good is inferior in home consumption.

C. Free-Trade Equilibrium

As usual, free-trade equilibrium requires equality among the domestic price ratio ($\bar{p}$), the world price ratio (g/E), and the marginal rate of substitution in home consumption (U_2/U_1):

$$g(E)/E = \bar{p} \qquad \ldots (9)$$

$$U_2(C_1, C_2)/U_1(C_1, C_2) = \bar{p} \qquad \ldots (10)$$

Equations (7), (8), (9) and (10) together are sufficient to determine all equilibrium values. Free-trade equilibrium may be illustrated in Figure 2 as follows. Home production is at D. The domestic and world price ratio is $\bar{p}$. Home consumption is at d, where indifference curve I-I touches the social budget line (for $\bar{p}$) drawn through D. The home country trades (at price ratio $\bar{p}$) to point d on foreign offer curve mDM, in this case importing the first good and exporting the second. Throughout this paper, equilibrium in world markets is assumed to be unique and stable.

D. The Consumption-Possibility Frontier

An important construction for Part II is the consumption-possibility frontier, or Baldwin (1948) envelope, which shows the maximum possible consumption level of one good for a given consumption level of the other good. This frontier is found by maximizing C_2, subject to a given level of C_1, and subject to equations (7) and (8). The first-order conditions of this maximization can be manipulated to yield

$$g'(E) = \beta \qquad \ldots (11)$$

whose unique solution is denoted $\tilde{E}$. Substituting $\tilde{E}$ into equations (7) and (8),

$$C_1 = \gamma - \beta C_2 \qquad \ldots (12)$$

where γ is a constant defined as $\gamma \equiv \alpha + g(\tilde{E}) - \beta\tilde{E}$. Equation (12) describes the consumption-possibility frontier, partially illustrated in Figure 2 by the straight line b_2b_1, which (given its slope of $-1/\beta$) is parallel to R_2R_1. Line b_2b_1 is part of the outer envelope traced by mDM, as the origin of mDM is allowed to slide along R_2R_1 with the axes of mDM kept parallel to those of R_2R_1.[13]

II. POLICY RANKING

This part shows how taxes and subsidies may be used to maximize welfare when different policy combinations are available. A welfare ranking is established for three such combinations, assuming that the home country has monopoly power in trade and remains incompletely specialized. Sections A, B and C consider respectively the third-best, second-best and first-best of the three policy packages analyzed. As the discussion progresses from the third-best optimum to the second-best and then to the first-best, the optimal level of employment increases with the optimal level of social welfare.

A. Taxes (Subsidies) on Trade

Suppose that trade taxes and trade subsidies are the only forms of commercial intervention available. These policies create a wedge between the domestic (producer and consumer) price ratio ($\bar{p}$) and the world price ratio (g/E). The *ad valorem* trade tax (subsidy), t, is then given by

$$t = \frac{[g(E)/E] - \bar{p}}{\bar{p}} \qquad \ldots (13)$$

when the home country imports the first good (with E, $g > 0$), and by

$$t = \frac{\bar{p} - [g(E)/E]}{g(E)/E} \qquad \ldots (14)$$

when the home country imports the second good (with E, $g < 0$). As $t \gtreqless 0$, trade is taxed, free or subsidized, respectively. Made here is a conventional assumption that the government redistributes (finances) all trade taxes (subsidies) in lump-sum fashion.

The formal problem for optimal trade policy is to maximize $U(C_1, C_2)$, subject to constraints (7), (8) and (10). The first order conditions of this maximization can be manipulated to yield

$$g'(E) = \beta \qquad \ldots (11)$$

The unique solution of equation (11), $\tilde{E}$ as before, can be substituted into equation (13) (if $\tilde{E} > 0$) or (14) (if $\tilde{E} < 0$) to calculate the optimal value of t, denoted $\tilde{t}$.

The optimal trade strategy is now illustrated in Figure 2 for the case of $E > 0$. Welfare maximization is achieved by moving up the income-consumption curve (r_2r_1) corresponding to constraint (10), until such movement is halted (at v) by the consumption-possibility frontier (b_2b_1) characterized by equation (11). The value of $\tilde{t}$ can be determined by comparing the slope of the domestic price line (Dd) with the slope of the (optimal) world price line (Vv). (V is the optimal production point where the origin of mDM lies when this curve touches b_2b_1 at v.) Figure 2 (in which v coincides with d and V coincides with D) shows the special case in which free trade is the optimal strategy. This prescription arises because the free-trade slope of mDM (at d) equals the slope of R_2R_1, thereby indicating that the second good's marginal cost (in terms of the first good) is the same through free trade as through domestic production. If mDM were redrawn slightly so that its free-trade slope at d were steeper (flatter) than R_2R_1 in Figure 2, the optimal policy would be a trade tax (subsidy) instead of free trade.

Whatever the value of $\tilde{t}$, the following two results always hold. First, the optimal trade strategy does not achieve full employment[14] (on T_2T_1 in Figure 2), and therefore is clearly not a first-best policy. Second, the optimal trade policy is not even second-best, since it leaves $U_2/U_1 = \bar{p} \neq \beta$, as at point v in Figure 2 where indifference curve I-I is not tangent to b_2b_1.

B. <u>Taxes (Subsidies) on Both Trade and Consumption</u>

Now suppose that it is possible to use consumption[15] tax-cum-subsidies, in addition to trade taxes (subsidies). The added policy gives an additional degree of freedom, by allowing a wedge between the domestic producer price ratio ($\bar{p}$) and the domestic consumer price ratio (equal to U_2/U_1). An <u>ad valorem</u> trade tax (subsidy) of t is still given by equation (13) or (14). An <u>ad valorem</u> consumption tax (subsidy) of τ, imposed on the first good, is given by

$$\tau = \frac{\bar{p} - [U_2(C_1, C_2)/U_1(C_1, C_2)]}{U_2(C_1, C_2)/U_1(C_1, C_2)} \quad . . . (15)$$

As $\tau \gtreqless 0$, consumption of the first good is taxed, unaffected or subsidized, respectively. It is assumed that all such consumption taxes (subsidies) are redistributed (financed) by the government in lump-sum fashion.[16]

The formal problem for optimal trade policy is now to maximize $U(C_1, C_2)$, subject to constraints (7) and (8) as before--but no longer subject to constraint (10) of the previous section, since τ is now available. The first-order conditions of this maximization can be manipulated to yield

$$g'(E) = \beta \qquad \ldots (11)$$

as before, and

$$U_2(C_1, C_2)/U_1(C_1, C_2) = \beta \qquad \ldots (16)$$

which differs from equation (10) since $\bar{p} \neq \beta$. The unique solution of equation (11), $\tilde{E}$ as before, can be substituted into equation (13) or (14) to yield the optimal t, which is clearly $\tilde{t}$ as before. That is, the optimal trade tax (subsidy) is the same whether or not it can be combined with the optimal consumption policy. By equations (15) and (16), the optimal value of τ (denoted $\tilde{\tau}$) is $\tilde{\tau} = (\bar{p} - \beta)/\beta$--which is positive (recalling $\bar{p} > \beta$), independent of $\tilde{E}$, and hence independent of $\tilde{t}$. Thus, consumption of the capital-intensive good should always be taxed at the same rate, no matter what the optimal trade tax (subsidy).

The optimal strategy is now illustrated in Figure 2. Welfare maximization is achieved by consuming on the consumption-possibility frontier (b_2b_1) characterized by equation (11), at the point (n) where an indifference curve (II-II) is tangent to b_2b_1 in accordance with equation (16). As before, $\tilde{t}$ is obtained by comparing the slope of the domestic producer price line (Dd) with the slope of the (optimal) world price line (Nn parallel to Vv). (N is the optimal production point where the origin of mDM lies when this curve touches b_2b_1 at n.) The value of $\tilde{\tau}$ is given by comparing the slope of the domestic producer price line (dD) with the slope of the (optimal) domestic consumer price line (b_2b_1).

Whatever the value of $\tilde{t}$ combined with (the positive) $\tilde{\tau}$, the following results always hold. First, optimal welfare and its corresponding level of optimal employment[17] always increase when $\tilde{\tau}$ is added to $\tilde{t}$--as in Figure 2, where welfare is greater at n than at v, and employment is greater at N than at V (recalling $dL/dX_2 > 0$). Second, combining $\tilde{t}$ with $\tilde{\tau}$ achieves the highest level of welfare consistent with production constraint (6), as in Figure 2 where n lies on the highest indifference curve consistent with production on R_2R_1. Third, the combination of $\tilde{t}$ and $\tilde{\tau}$ does not achieve full employment, and is therefore not a first-best policy package.

C. Taxes and Subsidies on Both Trade and Factors

Now suppose that it is possible to impose tax-cum-subsidies on factor use, in addition to trade taxes and trade subsidies. With an *ad valorem* labor subsidy of s, applied uniformly in both sectors, the producer's net cost of a unit of labor is $\bar{w}_2(1-s)$ in terms of good two. Under profit maximization, $\bar{w}_2(1-s) = MPL_2$, which implies

$$s = \frac{\bar{w}_2 - MPL_2}{\bar{w}_2} \qquad \ldots (17)$$

In other words, a labor subsidy can be used to drive a wedge between the marginal product of labor and the minimum wage. This subsidy may be financed either in lump-sum fashion, or by taxing capital uniformly in both sectors (since the supply of capital is perfectly inelastic). By combining a labor subsidy with a trade tax, it is possible to reach the first-best solution, as will now be shown.

If the wage were unconstrained, welfare could be maximized simply by application of the conventional (positive) optimal tariff, denoted t^*. Imposing t^* in the absence of wage rigidity would bring production to the first-best point on T_2T_1 in Figure 2, say point H, where labor's marginal product would be MPL_2^*. However, there actually is a binding minimum-wage constraint, which implies that $\bar{w}_2 > MPL_2^*$. (Recall that $\bar{w}_2$ has been specified to exceed the maximum MPL_2 consistent with full employment.) This optimal wedge between wage and marginal product at H can be created with an optimal labor subsidy (denoted s^*), given by $s^* = (\bar{w}_2 - MPL_2^*)/\bar{w}_2$ according to equation (17). This s^* must be applied (in both sectors) along with t^* to achieve the first-best solution. The unemployment effect of the minimum wage is cancelled by s^*, while t^* restricts trade to the conventional optimal level.[18]

This first-best policy combination goes directly to the sources of distortion, in keeping with the general prescription of Bhagwati and Ramaswami (1963). The labor subsidy is used to correct a domestic distortion due to wage rigidity in the home labor market. The trade tax is used to correct a foreign distortion arising from monopoly power in international trade.

FOOTNOTES

[1]This polarity has been pointed out by Bhagwati and Srinivasan (1973) who consider a third closely related type.

[2]Lefeber (1971) has also explored this case in a model with one consumer good and one investment good, instead of the two consumer goods of the traditional model.

[3]Rigidity of the nominal (instead of the real) wage need not lead to unemployment in the standard barter model of international trade, as pointed out by Johnson (1969).

[4]As shown by Brecher (1971), the following analysis could be extended readily for a minimum wage specified in terms of either the first good or a constant-utility combination of both goods.

[5]The minimum wage is treated here as a "fact of life" which, for social or political reasons, government and unions are unable or unwilling to alter within the time period considered in this paper. (This assumption does not rule out the longer-run possibility--not discussed in this paper--of varying the minimum wage by government action or by union response to the level of unemployment.) Consequently, for the welfare maximizations of Part II, the government treats the wage as a policy constraint rather than a policy tool. Admittedly, this type of constrained government also might be unable or unwilling to impose the labor subsidy required by the first-best solution, which is a reason for considering the other policy packages in the ranking.

[6]It is assumed that: $f_i(0) = 0$,

$\lim_{k_i \to \infty} f_i'(k_i) = 0$ and $\lim_{k_i \to 0} f_i'(k_i) = \infty$ for i = 1, 2; where f_i' is the derivative of f_i with respect to k_i.

[7]This result follows from the fact that full employment of both factors is consistent only with $k_2 \leq \bar{K}/\bar{L} \leq k_1$, as implied by the identity $K/L \equiv k_1L_1/L + k_2L_2/L$.

[8]Whether or not factor intensities reverse at some disequilibrium ω ($\neq \bar{\omega}$) is of no concern in this paper.

[9]For further discussion of the minimum-wage transformation curve, including the regions of complete specialization, see Brecher (1974) who shows the following two results. First, for all $p > \bar{p}$, production occurs at R_2. Second, for all $p < \bar{p}$, production occurs on R_1T_1, with output (and employment) rising as p decreases.

[10]These assumptions imply that the foreign elasticity of imports with respect to (relative) price is always greater than one in absolute value. If regions of inelastic foreign demand (with $g' < 0$) were allowed, the analysis would be more complicated algebraically (not geometrically), but there would be no change in any of the main policy results reported below. This invariance of conclusions has to do with the fact that an elastic foreign demand (with $g' > 0$) still would be a necessary condition at any of the optimal positions considered below.

[11]As shown by Bhagwati and Srinivasan (1969), welfare can be allowed to depend also upon non-consumption variables. In the present context, social welfare could be made to depend upon total employment in addition to aggregate consumption. For example, it could be assumed that social welfare is a concave function $W[U(C_1,C_2),L]$ of U and L; where $\partial W/\partial U > 0$ and $\partial W/\partial L > 0$, if U and L are both finite. The analysis of Part II could be reworked by maximizing W subject to the constraints of the system, in much the same way that U is maximized below. For the three

alternate policy combinations considered in this paper, their W-welfare ranking (in the case of W-maximization) would be the same as their U-welfare ranking (in the case of U-maximization performed below). Unsurprisingly, however, W-maximization would yield a smaller U and a larger L than does U-maximization--except under the first-best policy which would give the same U and the same L ($\bar{L}$) under either maximization.

[12]Use of community indifference curves may require socially optimal lump-sum transfers that depress labor's income below $\bar{w}_2$. If so, it is assumed that unions--which may be sufficiently powerful to force the producer to pay $\bar{w}_2$--are not strong enough to set a floor to labor's after-tax income. In other words, this paper is concerned with a (pre-tax) minimum-wage constraint, and not with a (post-tax) minimum-income constraint.

[13]For an illustration of the entire consumption-possibility frontier, including the non-linear parts corresponding to complete specialization in production, see Brecher (1971).

[14]In fact, imposing an optimal trade tax will decrease employment when the home country exports the labor-intensive good, as explained by Brecher (1974).

[15]Tax-cum-subsidies on production, instead of consumption, could be used to achieve the same welfare levels discussed below.

[16]An <u>ad valorem</u> consumption tax of τ_2, imposed on the second good, would imply $MPL_2 = \bar{w}_2(1 + \tau_2)$. Thus, variations in τ_2 would alter the equilibrium MPL_2, the equilibrium k_2 (which depends only on MPL_2 under constant returns to scale), and the minimum-wage transformation curve [which depends on k_2 as shown by equation (6)]. This complication is ruled out by assuming $\tau_2 = 0$. More generally, this complication would arise whenever the domestic consumer and the domestic

producer faced different money prices for the (second) good which defines the minimum wage--not the case under simply a trade tax or trade subsidy.

[17]However, if $\tilde{t} > 0$, imposing $\tilde{t}$ together with $\tilde{\tau}$ may reduce employment below the free-trade level when the home country exports the labor-intensive good, as suggested by footnote 14.

[18]The value of t^* would be zero if the home country had no monopoly power in trade, as in the case considered by Bhagwati (1968, pages 20-22). Thus, as he argued, only a labor subsidy would be needed then.

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