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MINIMUM WAGE RATES AND THE PURE THEORY OF INTERNATIONAL TRADE

Richard A. Brecher

May 1972

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MINIMUM WAGE RATES AND THE PURE THEORY OF INTERNATIONAL TRADE*

Richard A. Brecher

INTRODUCTION

Most of the pure theory of international trade deals with full-employment economies. By relaxing the usual assumption that the real wage is perfectly flexible, it is possible to focus upon a situation of unemployment. The present paper extends the standard Heckscher-Ohlin type analysis of an open economy to the case where the real wage of labour is subject to an exogenously specified floor or minimum. This floor--institutionally determined at the same level in all sectors of the economy--constrains the actual wage to exceed the wage required for full employment, so that the labour force is partially unemployed. Once market forces have bid the wage down to the minimum level, any of the given labour endowment not yet utilized forms a pool of unemployed who are willing to work at the going (minimum) wage but are unable to get hired. Producers in the minimum-wage economy hire no more labour from the pool of unemployed than is needed to satisfy demand and supply in world commodity markets. Bhagwati ([2],

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*This paper is a revision (with some extensions) of material from Chapters I, II, IV, and VIII (excluding its mathematical appendix) of my Ph.D. thesis [6].

For their guidance and encouragement of this work, I am deeply indebted and grateful to Richard E. Caves, chairman of my dissertation committee, and to Jagdish N. Bhagwati and Thomas O. Horst, members of this committee. I also wish to thank Michael B. Connolly, Richard N. Cooper, John C. H. Fei, Jonathan Goldberg James L. McCabe and Daniel M. Schydlowsky for comments on all or parts of the material at various stages of its preparation. Of course, I alone am responsible for any remaining errors or shortcomings.

pages 17-22) has described this type of factor-market imperfection as the case where the actual wage is constrained to be above the optimal or shadow wage. This situation must be distinguished, as pointed out by Bhagwati, from two other cases--the case of a distortive wage differential (e.g., Bhagwati and Ramaswami [5]), and the case in which the wage diverges from the marginal product of labour in an activity (e.g., Fei and Ranis [7] and Lewis [14]).

Once the general equilibrium model is set up, it is possible to examine its comparative static properties for various parametric shifts. It is well known that a parametric shift will create (before full adjustment occurs) excess demands and supplies in world commodity markets, and corresponding excess demands and supplies in domestic factor markets (as labour and capital are reallocated between sectors of unequal factor proportions). Any excess demand for or supply of labour, that would drive the real wage up or down in the standard full-employment model, will instead raise or lower the level of home employment in the present minimum-wage model, respectively. Employment, not the wage rate, now bears the burden of adjusting to the international equilibrium. Domestic social welfare (in the Pareto sense) is another variable, like domestic employment, whose comparative static response receives special attention below.

It may be helpful to relate the present treatment of real factor-price rigidity to three earlier discussions, by Bhagwati ([2], the third of three cases that he analyzes on pages 17-22), Haberler [8], and Johnson [9]. Neither Haberler nor Johnson specifies the wage floor exogenously; instead, they both take the initial level of employment and corresponding

wage as given, treating this wage as the minimum. In the present discussion, however, the minimum is exogenously given and affects the initial level of employment. Bhagwati exogenously fixes the actual wage, rather than the minimum, ruling out both upward and downward flexibility. In the present discussion, on the other hand, upward flexibility is not impossible (since full employment, instead of the minimum wage, could be the binding constraint under certain conditions); although, in the most interesting case, the home economy always operates with unemployed labour whose presence prevents the equilibrium wage from rising above the floor. With Haberler and with Johnson, rigidity applies in some cases to factor prices in general; whereas, with Bhagwati and in the present analysis, only one factor price at a time is ever less than perfectly flexible. (Although only the case of a minimum real wage is considered explicitly below, the analysis would be similar in the event of a floor to the real return on capital instead of the wage.) Bhagwati, Haberler, and Johnson all take world prices as given, whereas the present treatment also considers the case in which the home country has monopoly power in trade. The two major concerns of this previous literature on factor-price rigidity are: to compare free trade with autarchy, by considering the employment and welfare effects of imposing or abolishing a prohibitive tariff; and, to determine optimal (i.e., welfare-maximizing) commercial policy. The first of these two issues is re-examined, more extensively and more generally, in (Part II, Section B of) the present paper which also examines the impact of non-prohibitive tariffs (Part IV). A more detailed examination of the second of these two issues is one subject of a future study (and may also be found in Brecher [6], Chapter IX), although a few comments on

optimal trade intervention are offered below (Part IV). A brief summary of other aspects of the present paper is contained in the following overall outline.

The material is divided into four parts. Part I sets up the basic model of a minimum-wage economy, by deriving the following three equilibrium relationships: the transformation curve, shown to be composed of linear segments; the consumption curve, or locus of aggregate consumption bundles; and the offer curve, shown to have a linear segment. Part II introduces a conventional foreign offer curve to determine equilibrium in all markets including the home labour market, and then shows that: 1) a minimum wage in just one country may be sufficient to restrict the wage in both countries to the home floor; 2) a move from autarchy to free trade may decrease home employment and home welfare--not the case in the absence of a minimum wage; and 3) imposing a minimum-wage constraint in a free-trade situation may improve home welfare (despite a fall in employment), and may reverse the direction of trade (in which case welfare decreases).

Some comparative static properties of the model are explored in the final two parts. A number of the results derived there would not be reached in the absence of a minimum wage. Part III shows that a shift in foreign demand in favour of home exports may reduce home employment and home welfare. In Part IV, which analyzes changes in home tariffs, the more general conclusions include the following: 1) when a tariff is raised, home employment may decrease, although an increase (decrease) in home welfare may accompany a decrease (increase) in employment; 2) when the home country has monopoly power in trade, optimal trade intervention (in the

absence of complementary policy) is not necessarily a tariff, but instead may be a trade subsidy or simply free trade; and 3) when it has no monopoly power in trade, the home country may be worse off with free trade than with a tariff or a trade subsidy. The method of comparative statics used here may be adapted readily for analysis of other parametric shifts not considered explicitly below, as shown by Brecher [6].[1]

I. DOMESTIC EQUILIBRIUM

This part discusses the equilibrium relationships in the minimum-wage (home) economy, treating production in Section A, consumption in Section B, and the offer in Section C. Determination of the actual equilibrium is left for the following part where the model is completed by introducing foreign demand.

A. Production

The transformation curve, showing the equilibrium quantities produced at each commodity-price ratio, is derived in this section. Also illustrated here is the equilibrium relationship between the product-price ratio and the level of overall labour employment. Since the transformation curve turns out to depend on market relationships and entrepreneurial behaviour, in addition to technology and the levels of total factor employment, it is not a conventional production-possibility frontier (which depends only on technology and total employment levels). The terms "transformation curve" and "production-possibility frontier" will always be used in these different ways to distinguish the market equilibrium schedule from the purely

technical schedule, respectively.

Consider the familiar case of a simple economy in which two commodities, one and two, are produced with two homogeneous primary factors of production, labour and capital. For each good, the level of technology is given and production exhibits constant returns to scale. Producers maximize profits in both industries (and, when demand is introduced in Section B below, consumers maximize utility), in an environment that is entirely free from externalities. Except for the wage floor (to be specified), perfect competition prevails. It is assumed throughout that good two is more labour-intensive (i.e., uses a larger labour/capital ratio) than good one at every common factor-price ratio.[1a] Labour and capital are perfectly mobile domestically (though completely immobile internationally), so that each factor's reward is the same in both sectors. The real wage of labour may be denoted by

$$w_1/p = w_2$$

where w_i ($i = 1, 2$) is the real wage in terms of commodity i, and equals the marginal product of labour in industry i because of profit maximization; and p is the relative price of the second good in terms of the first.

At this point, it is important to decide how to define the minimum wage. Consider the following three separate possibilities, where in each case some institutional[2] arrangement (such as custom, law, or labour unions) sets and enforces the minimum real[3] wage at the same level in both[4] sectors of the economy. If the minimum wage is specified in terms of the second good, at some particular level denoted by $\bar{w}_2$, then the

minimum-wage constraint may be written as

$$w_1/p = w_2 \geq \bar{w}_2 \qquad \ldots (1)$$

Instead, the minimum could be fixed in terms of the first commodity, at some specific level denoted by $\bar{w}_1$, in which case the minimum-wage constraint would be

$$pw_2 = w_1 \geq \bar{w}_1$$

Finally, the minimum wage could be defined alternatively in terms of a constant-utility combination of both goods. Only the first case, as expressed by constraint (1), is treated explicitly in the present paper. The analysis, however, could easily be extended to the other two cases (as shown by Brecher [6], Chapter I), and these two cases are summarized briefly without proof in footnote 19 below.

The total employment levels of labour and capital are constrained to be less than or equal to fixed factor endowments, with no possibility of international factor mobility. The supply of capital is assumed to be perfectly inelastic at the given endowment, so that the total capital stock is always fully utilized. In the absence of wage rigidity, the supply of labour (by assumption) also would be perfectly inelastic at the given endowment. Given the institutionally-imposed wage floor, however, the effective supply of labour--although still perfectly inelastic (at the given endowment) for any above-minimum wage--is now perfectly elastic at the minimum wage (with a maximum supply set by the given endowment).[5] Therefore, there is no assurance that the total labour force

will be fully employed.[6] Since labour but not capital can be unemployed, any mention of variations in total employment will always refer only to labour unless otherwise stated.[7]

In Figure 1, T_2T_1 is the full-employment (conventional) production-possibility frontier, drawn for the given endowments of labour and capital. Because labour may be partially unemployed, production may take place at points below T_2T_1. It is assumed, initially, that the minimum wage (in terms of good two) is fixed at the level defined by the marginal product of labour (in industry two) at point R_2° on T_2T_1. In this case, the transformation curve turns out to be $T_2R_2^\circ R_1^\circ T_1$, and now is derived by considering output (and employment) equilibrium at each individual product-price ratio.

Let p° be the first product-price ratio quoted to producers. Given p°, maximum profits could be made by producing at R_2° (where the budget line for p° is tangent to T_2T_1) and paying labour its marginal product at R_2° which (as will be recalled) equals the minimum wage. Therefore, R_2° is a possible output equilibrium, since (given p°) this point satisfies the (tangency) condition of profit maximization without violating the minimum-wage constraint. As will now be shown, R_2° is only one of many possible output equilibria corresponding to p°. (This indeterminacy in production will be eliminated, in general, later in the discussion when demand for commodities is eventually introduced.)

To find another possible output equilibrium for p°, consider a decrease in total employment of labour (with total utilization of capital held constant at the given endowment) that would shift the production-

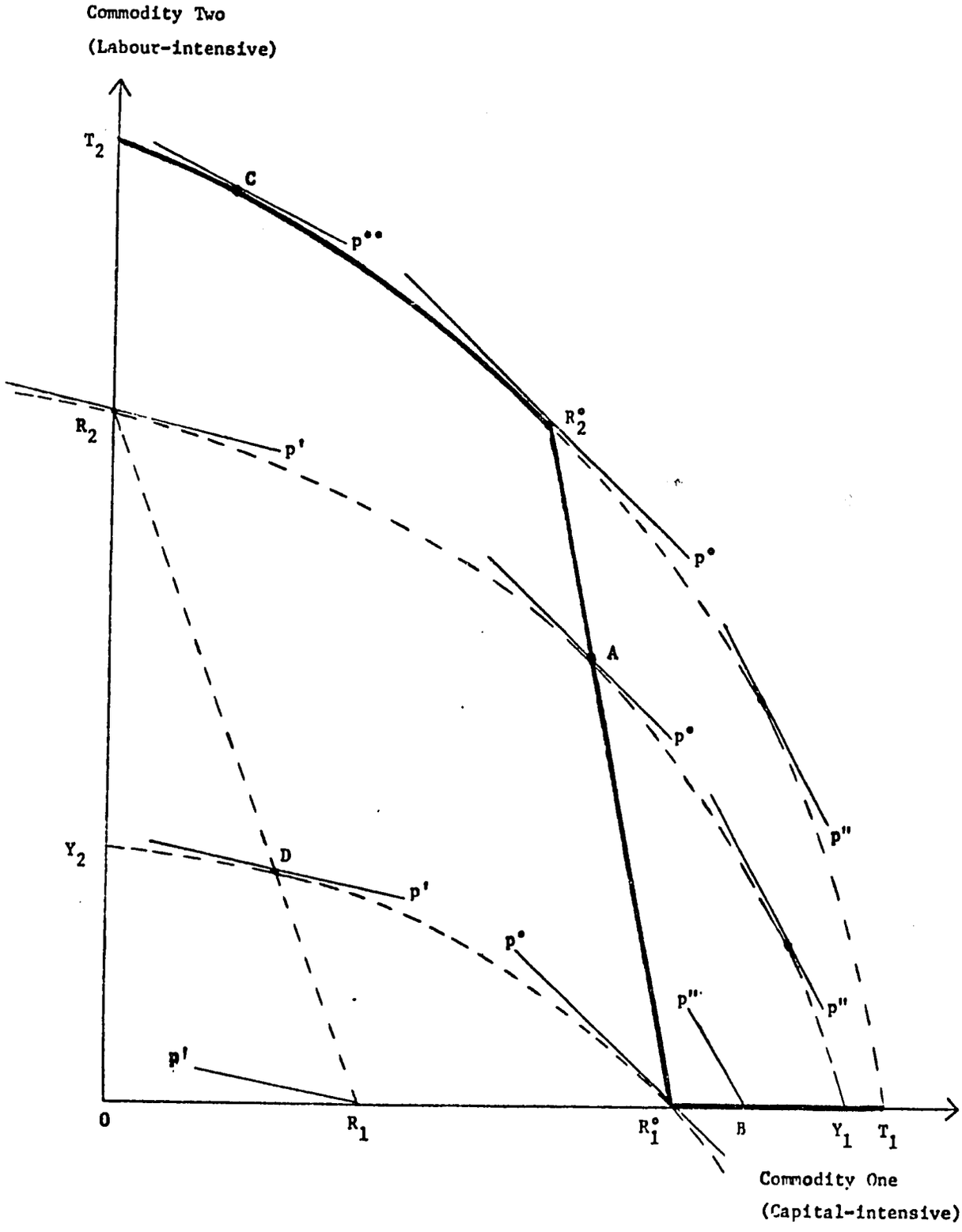
Commodity Two
(Labour-intensive)
T_2
C
p**
R_2
p'
R_2^o
p°
A
p°
p"
Y_2
D
p'
p°
p"
p"
p'
0
R_1
R_1^o
B
Y_1
T_1
Commodity One
(Capital-intensive)

Figure 1

possibility frontier inwards to R_2Y_1. With the price ratio constant at p°, profits could be maintained at the maximum level (always zero under constant returns to scale) by shifting production from point R_2° to point A (where the budget line for p° is tangent to R_2Y_1). This shift from R_2° to A, at constant price ratio p°, would leave the profit-maximizing wage unchanged at the minimum level--by application of the well-known Samuelson [18] price relationship between the product-price ratio and (relative and absolute) factor rewards.[8] Since profits could be maximized at A by paying labour the minimum wage, and since unemployed labourers could not try to regain their lost jobs by bidding the wage below the floor (as they would if the wage were perfectly flexible), there would be no pressures at A driving the economy away from this point. Therefore, A is another possible output equilibrium for p°.

By similar reasoning, production equilibrium (given p°) can occur (with a wage equal to the minimum) anywhere on the line $R_2^\circ R_1^\circ$--each of whose points (like R_2°, A, or R_1°) is the point of tangency between a budget line for p° and a production-possibility frontier (T_2T_1 for R_2°, R_2Y_1 for A, or $Y_2R_1^\circ$ for R_1°), with each of these frontiers drawn for a different level of total labour employment (but always for the given stock of fully-employed capital). The line $R_2^\circ R_1^\circ$, known in trade theory as the Rybczynski line for price ratio p°, must be both negatively-sloped and (given that commodity two is relatively labour-intensive) steeper than the budget line for p°--by application of the Rybczynski Theorem [17].[9] Since the real wage is constant (at the minimum level) along $R_2^\circ R_1^\circ$, the labour/capital ratio in each industry must be constant along $R_2^\circ R_1^\circ$ (by the assumption of constant

returns to scale)--thereby implying that this line is straight.[10] The level of total labour employment, and hence the aggregate labour/capital ratio (given full employment of capital), clearly decrease along $R_2^\circ R_1^\circ$ as industry two contracts: for at the constant factor proportions in each sector, a shift of resources from the second industry to the first frees more labour from the labour-intensive former than can be abosrbed by the capital-intensive latter; and the excess labour, unable to bid the wage below the minimum, flows into the pool of unemployed.

Now suppose that the quoted price ratio falls to any level below p° (say to level p''). Since the budget line for the new price ratio (p'') is steeper than the production-possibility frontier through each point on $R_2^\circ R_1^\circ$, commodity two is now unprofitable relative to commodity one at any initial point (say A) on $R_2^\circ R_1^\circ$. Therefore (starting at A), resources begin shifting out of the second industry and into the first. To re-establish profitablity of industry two, and hence profitability of incomplete specialization (at any point on the undrawn Rybczynski line for p''), the wage would have to decline in terms of both goods to some sub-minimum level--by application of the Stolper-Samuelson Theorem [19][11]--given that the relative price of the labour-intensive good has declined below the level (p°) associated (under incomplete specialization) with the minimum wage. Because the wage floor prevents this decline in the real wage, the second industry and incomplete specialization remain unprofitable. Therefore, flows of resources must lead to complete specialization in commodity one.[12] Output equilibrium (for p'') occurs at a unique point (like B), which may be located by imagining the following two-step path of adjustment. First, it

is possible to think of the economy as moving (from the initial equilibrium A) down $R_2^\circ R_1^\circ$, through decreasing levels of employment, eventually achieving complete specialization at R_1°. Recall that the wage at R_1° just satisfied the minimum-wage constraint when the price ratio was p°. Thus, since the price ratio has now fallen below p° (to p''), unemployed labour at R_1° could bid the wage (and marginal product of labour) down proportionately in terms of the first good without violating the minimum-wage constraint (1) in terms of the second good. By this process of bidding, employment and output increase above the R_1° levels (recalling that the given capital stock is always fully utilized). This second step of adjustment takes the economy rightwards along $R_1^\circ T_1$, past R_1°, to the new equilibrium point (B in the case of p'').[13] As clearly implied by this reasoning, the further the price ratio falls below p°, the greater are the equilibrium levels of employment and output along $R_1^\circ T_1$. Sufficiently small values of p are capable of achieving full employment at T_1.

Finally, let the quoted price ratio rise to any level above p° (say to level $p^{\circ\circ}$). By reversing the reasoning of the previous paragraph, given any initial point (say A) on $R_2^\circ R_1^\circ$, resources begin moving out of the first industry and into the second. Profits could be maintained at the maximum level by shifting production to the point (C) where the budget line for the new p ($p^{\circ\circ}$) is tangent to $T_2 R_2^\circ$. Since the relative price of the labour-intensive good has risen (from p° to $p^{\circ\circ}$), the profit-maximizing wage increases (in terms of both goods) from the minimum level (at A) to some above-minimum level (at C)--by application of the Stolper-Samuelson Theorem [19]. Therefore (given $p^{\circ\circ}$), output equilibrium can occur on $T_2 R_2^\circ$ at the

tangency point (C) in question, where maximization of profits does not violate the minimum-wage constraint. Furthermore, it is not possible (given $p^{\circ\circ}$ and its corresponding above-minimum wage) to find another output equilibrium (additional to C) by reducing the level of employment, since unemployed labour would not cease trying to bid the (above-minimum) wage down to the floor.[14] It is possible to imagine the economy adjusting to equilibrium by first moving (from the initial equilibrium point A) up $R_2^\circ R_1^\circ$ through increasing levels of employment, and then leftwards along $T_2R_2^\circ$ (to the new equilibrium point C) through increasing levels of the real wage.

In summary, the entire transformation curve is $T_2R_2^\circ R_1^\circ T_1$, given the initially chosen minimum wage (defined by the marginal product of labour at R_2°). In the present context where the main focus is on unemployment, the segment $T_2R_2^\circ$ is not especially interesting, since along $T_2R_2^\circ$ the economy operates in the well-known full-employment manner with the minimum wage not great enough to be a binding constraint. To concentrate on the less-known cases of unemployment, it is desirable to remove $T_2R_2^\circ$ from the transformation curve by respecifying the minimum wage at a sufficiently higher level. As the minimum wage is raised, its corresponding p under incomplete specialization increases above p° (by the Stolper-Samuelson Theorem [19]), and therefore the associated Rybczynski line shifts leftwards. Suppose that the new increased minimum wage corresponds to p' and hence to the Rybczynski line for p', R_2R_1.[15] (The budget lines for p' are flatter than T_2T_1 at T_2.) By previous reasoning, in Figure 2 (which reproduces the essentials of Figure 1) production equilibrium is now on R_2R_1 for $p = p'$,

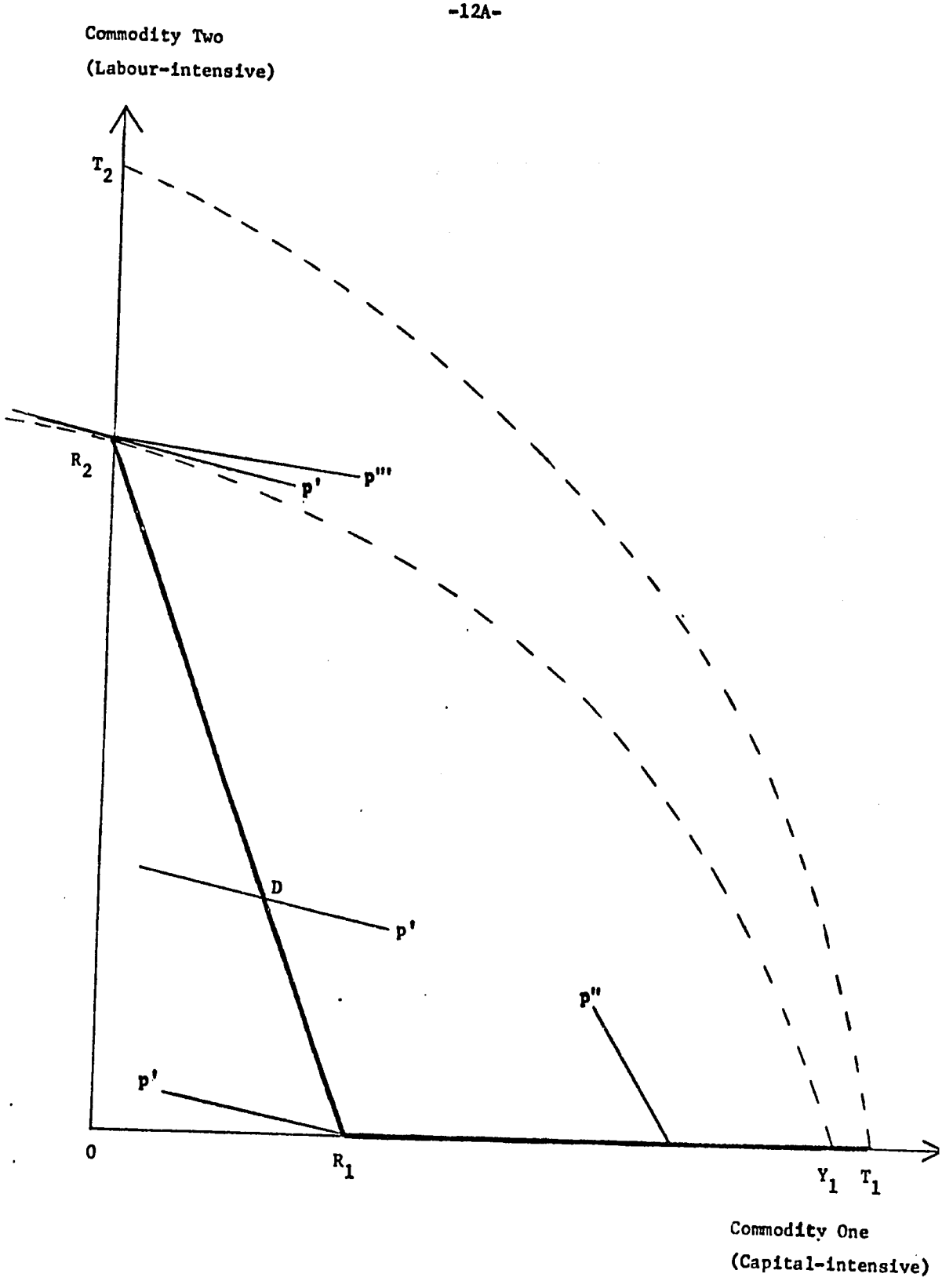
Commodity Two
(Labour-intensive)
T_2
R_2
p'''
p'
D
p'
p''
p'
0
R_1
Y_1
T_1
Commodity One
(Capital-intensive)

Figure 2

and on R_1T_1 for all $p < p'$ (with employment and output increasing as p decreases). For each $p > p'$ (say p'''), equilibrium can no longer be achieved at any profit-maximizing point of incomplete specialization (on the undrawn Rybczynski line for p'''), because each such point would involve both an above-minimum wage (by application of the Stolper-Samuelson Theorem [19]) and unemployed labour attempting to bid this wage down to the floor (since the undrawn Rybczynski line for p''' lies left of R_2R_1 and hence entirely below T_2T_1). Thus, for all $p > p'$, resources shift out of the first industry and into the second (by previous reasoning) until the economy is completely specialized in commodity two at R_2, where the condition of profit maximization is met (in the form of a corner solution with the budget line for p''' flatter than R_2T_1), and where labour's marginal product in industry two equals the minimum wage (as at all points on R_2R_1). Since labour's equilibrium wage (and marginal product) cannot fall in terms of good two, production cannot move up R_2T_2 as p rises further above p'. The entire new transformation curve is $R_2R_1T_1$.[16]

Raising the minimum wage has not only ruled out incomplete specialization at full employment, but has also admitted the interesting possibility of unemployment under complete specialization in good two (at R_2).[17] Since $R_2R_1T_1$ lies below T_2T_1 except at point T_1, there is some unemployment at all points except T_1, so that the minimum-wage constraint (1) is necessarily binding at all points except T_1.[18] To concentrate on cases of unemployment, it is assumed throughout the remainder of the discussion, unless stated otherwise, that the economy does not operate at T_1. Also, $R_2R_1T_1$ is the only transformation curve considered throughout the rest of the analysis.[19]

B. Consumption

Consider Figure 3, which reproduces the transformation curve $R_2R_1T_1$ from Figure 2. For each p (say p') and corresponding point (for example, D) on the transformation curve, there is a social budget line (drawn through D with slope -1/p') along which consumption is assumed to occur at the point (d) where a conventional community indifference curve is tangent to the budget line. The locus of all such consumption points is ir_2r_1e, and will be called the consumption curve. The segments ir_2, r_2r_1 and r_1e correspond respectively to the three segments of the transformation curve R_2, R_2R_1 and R_1T_1. Assuming that r_2r_1 is continuous, it must clearly intersect R_2R_1 at least once (although perhaps only at an endpoint), as at point a. It is assumed throughout, unless stated otherwise, that neither good is inferior.[20] Therefore, r_2r_1 must have a positive slope throughout and hence must cut R_2R_1 only once.[21] The segments r_2i and r_1e are drawn to reflect the fact that, when there is complete specialization in production, a rise in the relative price of the commodity produced must increase the consumption of the other good (given that the latter is not inferior).

C. The Offer

For each p (say p') and corresponding production-cum-consumption combination (e.g., D-cum-d) in Figure 3, there is an offer of exports (Md) for an equal market value of imports (DM), with this offer represented in the familiar manner by an offer triangle (dMD). Placing all such triangles into Figure 4 (where triangle SJO represents the equal triangle dMD of Figure 3) gives rise, in the usual way, to the offer curve $U_2A_2A_1U_1$. The autarchy point O in Figure 4 corresponds to point a in Figure 3.

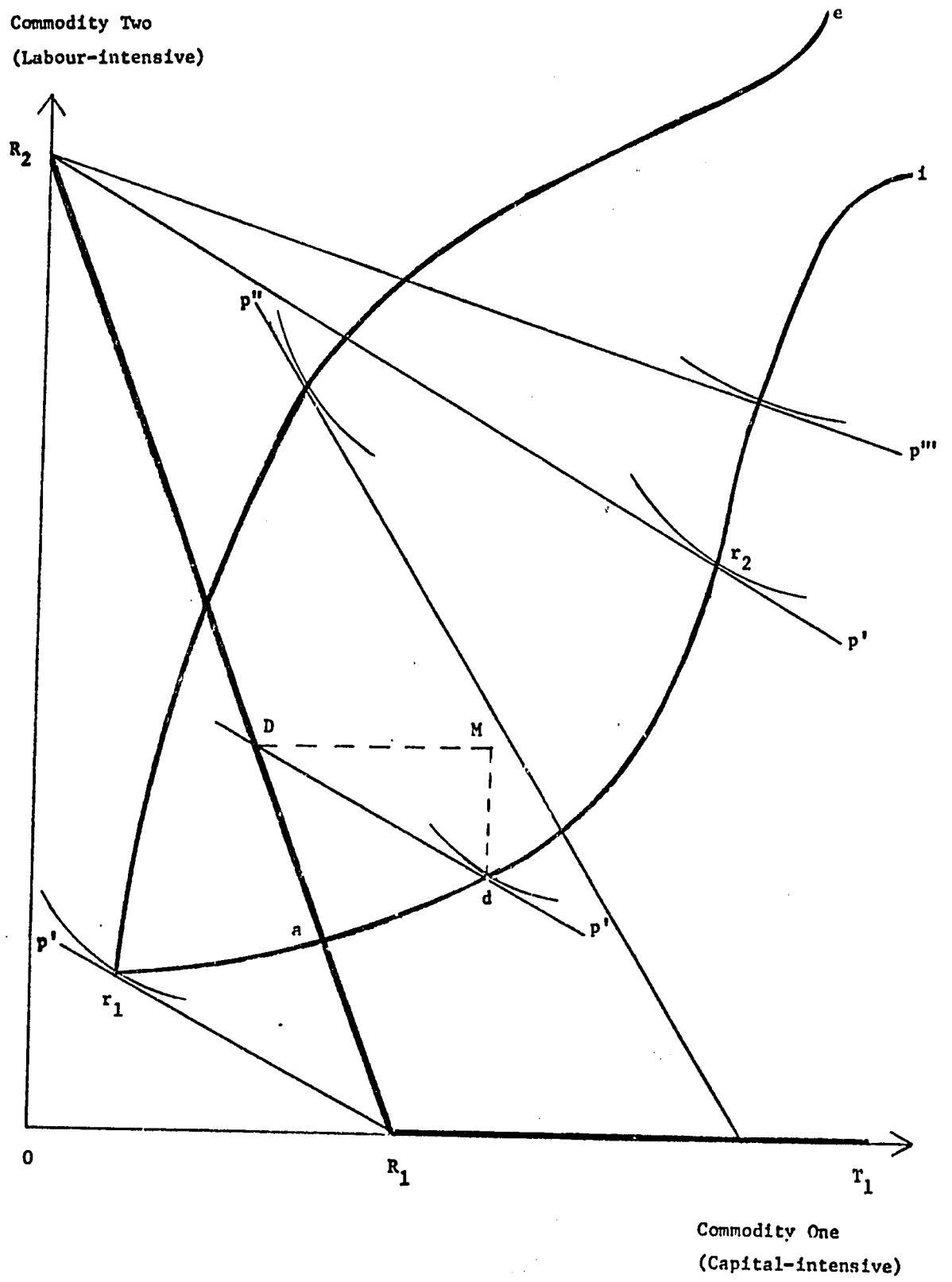
Commodity Two
(Labour-intensive)
R_2
e
i
p''
p'''
r_2
p'
D
M
d
a
p'
p'
r_1
0
R_1
T_1
Commodity One
(Capital-intensive)

Figure 3

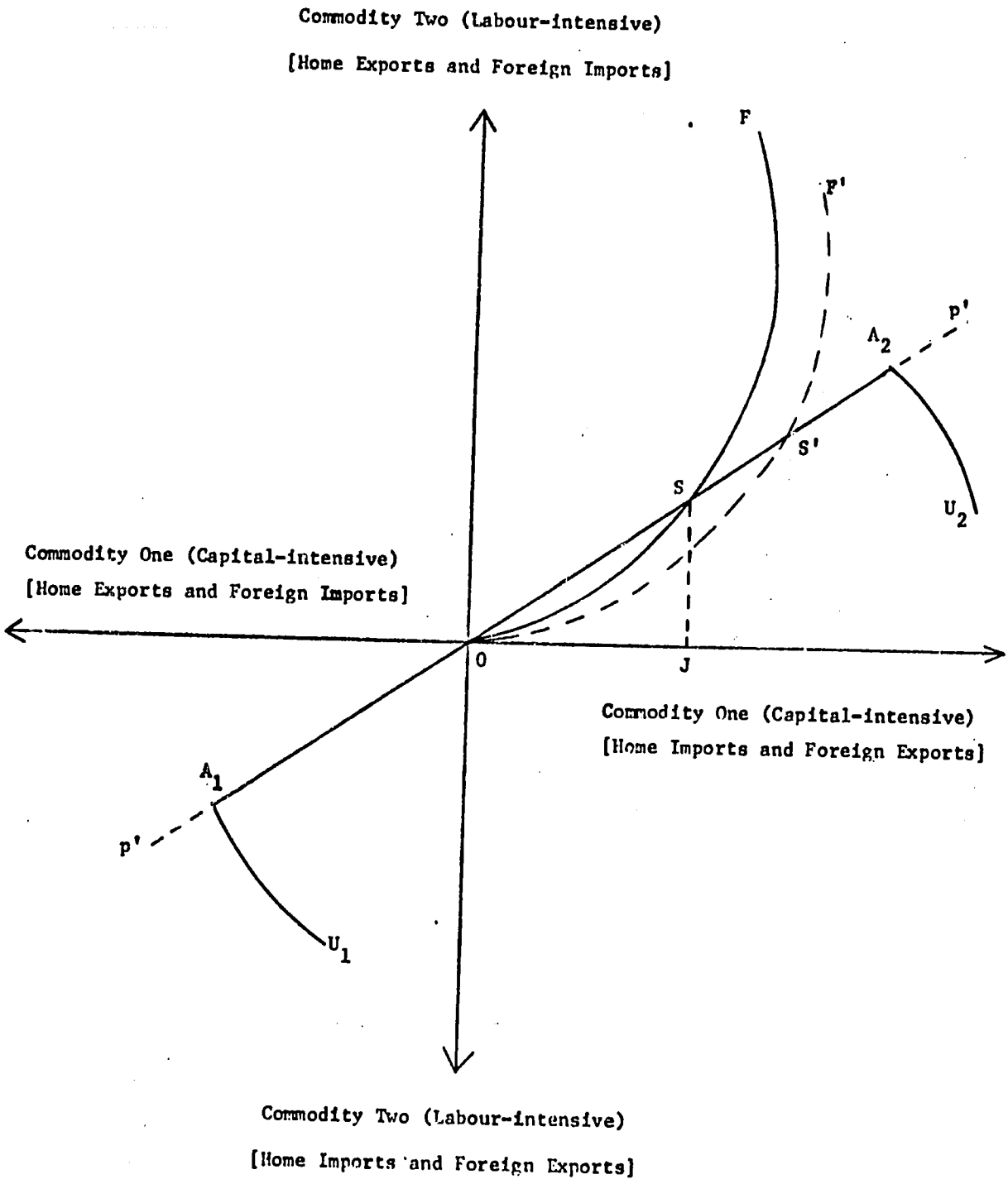
Commodity Two (Labour-intensive)
[Home Exports and Foreign Imports]
F
F'
p'
A2
S'
S
U2
Commodity One (Capital-intensive)
[Home Exports and Foreign Imports]
O
J
Commodity One (Capital-intensive)
[Home Imports and Foreign Exports]
A1
p'
U1
Commodity Two (Labour-intensive)
[Home Imports and Foreign Exports]

Figure 4

Moving continuously up A_2A_1 in Figure 4 corresponds to moving continuously up R_2R_1 and r_2r_1 in Figure 3, at price ratio p', through successively greater levels of employment and welfare. With continuous movements along A_2U_2 towards U_2 (Figure 4), employment and output are constant at the R_2 levels (Figure 3), but the economy moves continuously up r_2i (Figure 3) through successively greater levels of welfare. Moving continuously along A_1U_1 towards U_1 (Figure 4) corresponds to continuously rightward movements along R_1T_1 and r_1e (Figure 3), through successively higher levels of employment and welfare. The segments A_2U_2 and A_1U_1 (Figure 3) cannot bend back to the origin (i.e., home imports must not decrease when their relative price falls), since the importable is not inferior.

Although segments A_2U_2 and A_1U_1 have been drawn inelastic, none of the subsequent analysis would be upset if these segments were instead drawn elastic. (Throughout this paper, unless otherwise stated: the elasticity of an offer curve is taken to be the price-elasticity of imports; and as this elasticity is greater or less than one, the offer curve is said to be elastic or inelastic, respectively.) Since employment (and hence output) does not respond to product-price changes when specialization is complete in good two, the elasticity of A_2U_2 equals the elasticity of the conventional (constant-employment, all-prices-flexible) offer curve (drawn in the usual way for a conventional production-possibility frontier). But because employment (and hence output) does respond to commodity-price changes when specialization is complete in the first good, the elasticity of A_1U_1 exceeds the elasticity of the conventional offer curve by the amount of the price-induced employment effect on imports.

II. INTERNATIONAL EQUILIBRIUM

The opportunity to trade internationally is represented by a conventional well-behaved foreign offer curve, such as OF in Figure 4. World equilibrium occurs at the point--assumed to be unique--where the foreign offer curve intersects the home offer curve. At this point, S in Figure 4, domestic as well as world markets are in equilibrium, and the level of home employment is uniquely determined.

Stability of equilibrium in world commodity markets requires, as usual, that the foreign price-elasticity of imports and the home price-elasticity of imports sum to more than unity. This condition is clearly met when the home country is incompletely specialized, since the home elasticity is then infinite. When the home country is completely specialized, the stability condition is assumed to hold. (In fact, the previously assumed uniqueness of world equilibrium guarantees stability.) In the home regions of incomplete specialization (A_2A_1, excluding A_2 and A_1) and complete specialization in the first commodity (A_1H_1), where the elasticity of the home offer curve exceeds the elasticity of the conventional (constant-employment, all-prices-flexible) home offer curve (recalling the end of Section C, Part I), the stability condition can be satisfied with the present minimum-wage offer curve even when not satisfied with the conventional offer curve.

A. Factor-Price Equalization

A (binding) minimum-wage constraint has an interesting, though not surprising, implication for factor-price equalization. If both countries are

incompletely specialized under free trade (in which case equilibrium must occur on A_2A_1 in Figure 4), and if all other standard assumptions for factor-price equalization (see Samuelson [18]) are made, then the equilibrium wage in both countries equals the home minimum. That is, under these circumstances, a minimum-wage constraint in just one country is sufficient to restrict the wage in both countries to the home floor.

If, however, the foreign country were then to impose its own (binding) minimum-wage constraint, the offer curve of each of the two countries would have the Ricardian shape (like $U_2A_2A_1U_1$), and therefore at least one country would be completely specialized--assuming that the two wage floors were not identical, so that the straight-line segments of the two offer curves did not coincide. Thus, in this case, the wage would not be equalized internationally, but instead each country's real wage would be given by its own minimum.

B. Free Trade versus Autarchy

Recalling (from Section C of Part I) how employment and welfare vary along the home offer curve, it is a straightforward exercise to compare the free-trade levels of employment and welfare with the levels under autarchy.

If free trade leads the home country to export good two, employment and welfare both rise above the autarchy levels as the equilibrium offer moves up OA_2U_2 from 0 to some point like S in Figure 4. (Correspondingly, in terms of Figure 3, the economy moves from point a, up aR_2 in production to some point like R, and up ar_2i in consumption to the corresponding point d.)

In the event that free trade leads the home country to export good one, what happens to employment and welfare depends upon the degree of free-trade

specialization in home production. If, in this case, home production remains incompletely specialized, then employment and welfare decline below the autarchy levels as the equilibrium offer moves from point 0 to some lower point on $0A_1$. (Correspondingly, in Figure 3, the economy moves from point a downwards along aR_1 and ar_1.) But if, instead, the home country ends up completely specialized while exporting the first commodity, then employment and/or welfare could (but need not) rise above the autarchy levels as the equilibrium offer shifts from point 0 to somewhere on A_1U_1. (Correspondingly, in terms of Figure 3, the economy moves from point a to some production level on R_1T_1 and some consumption level on r_1e.) In this last case, welfare can improve even when employment decreases--provided the home terms of trade improve sufficiently.[22]

C. Wage-Constrained Free Trade versus Wage-Flexible Free Trade

A (binding) minimum-wage constraint, imposed in an initial wage-flexible free-trade situation of full employment, will reduce the level of home employment below the endowment level---except in the special case, ruled out by assumption (on page 13 above), in which the resulting wage-constrained equilibrium involves complete specialization at point T_1 in Figure 3. Home welfare, however, may still increase provided the home terms of trade improve sufficiently, as shown by the following example in Figure 5 (which reproduces T_2T_1 and $R_2R_1T_1$ from Figure 2). In the absence of the wage floor, the equilibrium world price ratio is p^{oo}, the home country produces at C, and home consumption is at c on indifference curve I-I. Imposing the wage constraint then raises the equilibrium world price ratio to p' (implying that the home country has monopoly power in trade), and leads the home

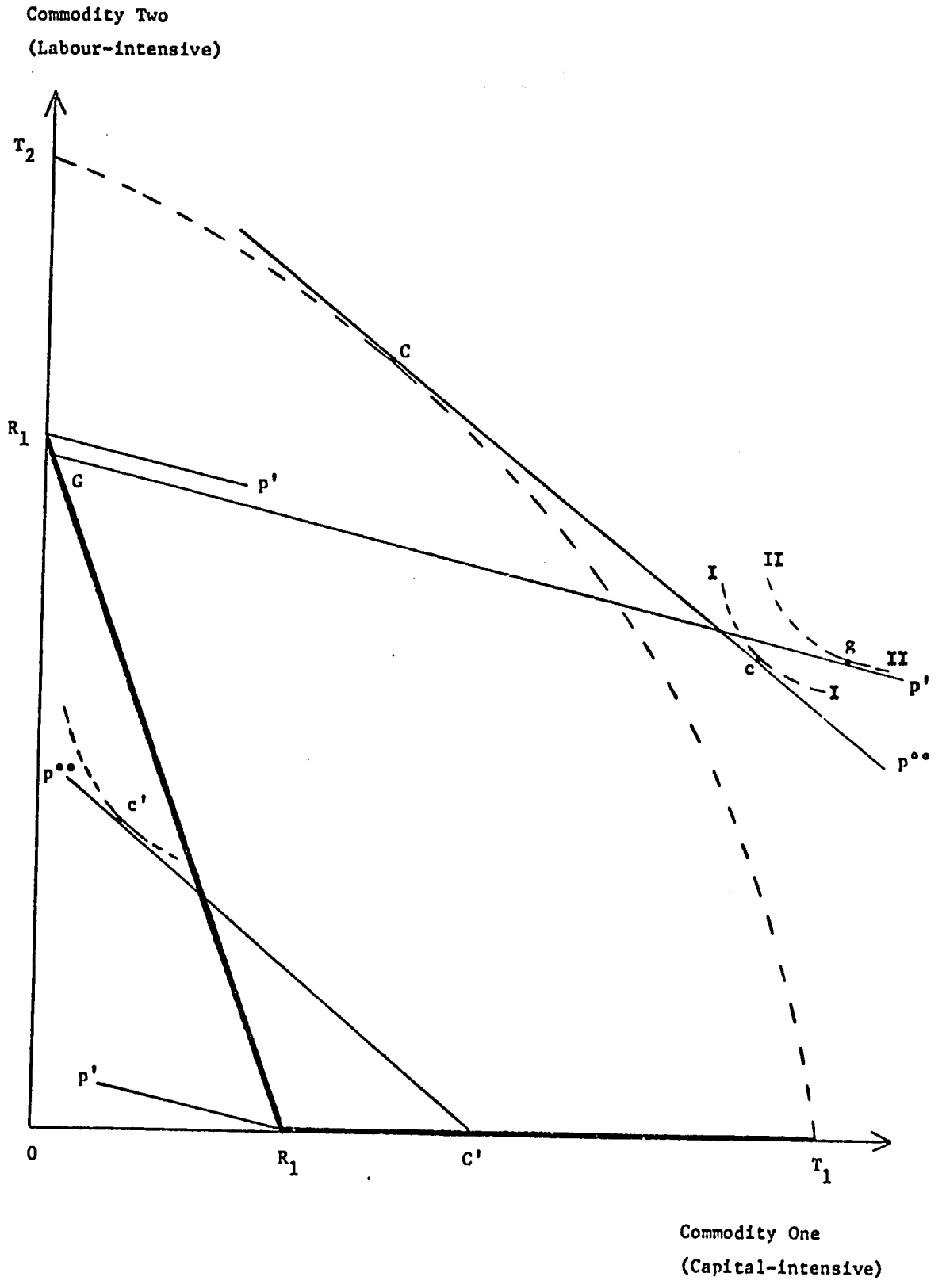
Commodity Two
(Labour-intensive)
T_2
C
R_1
G
p'
I
II
g
II
c
I
p'
p''
p''
c'
p'
0
R_1
C'
T_1
Commodity One
(Capital-intensive)

Figure 5

country to produce at G and consume at g on higher indifference curve II-II.

Restating this proposition in reverse, the removal of a (binding) minimum-wage constraint may reduce the home free-trade level of welfare when the home country has monopoly power in trade. This possibility of welfare loss through employment expansion, in the event of abolishing a wage floor, is analytically similar to the familiar case of immiserizing growth (discussed by Bhagwati [3]). Furthermore, this possibility of a deterioration in welfare, as a result of the abolition of a domestic distortion (due to the minimum-wage constraint) when there is a continuing foreign distortion (due to monopoly power in trade), illustrates the general proposition (see Bhagwati [4], Proposition 6, page 86) that reducing the "degree" of only one of several distortions will not necessarily increase welfare.

Although the home country exports the second commodity in the foregoing example of Figure 5, it would not be difficult to construct other examples in which the imposition of a wage floor increases welfare when the home country exports the first good. These latter examples would imply, as could easily be shown, complete (home) specialization in commodity one under wage-constrained free trade and (assuming no inferiority in consumption) an inelastic foreign offer curve.

The imposition of a minimum-wage constraint may reverse the direction of trade when the home country exports the second good under wage-flexible free trade, as shown by the following example in Figure 5. Suppose now that the home country has no monopoly power in trade, so that the world

price ratio remains constant at p^{oo} ($<p'$). Before the wage floor is imposed (given $p = p^{oo} < p'$), home production is at C, home consumption is at c, and commodity two is the home export. When the wage constraint is imposed (given $p = p^{oo} < p'$), home production becomes specialized completely in the first good (by the reasoning of Part I for the case of all $p < p'$) at point C', home consumption shifts to c', and the home country becomes an exporter of commodity one (implying a reversal in the direction of trade). It could easily be shown that a trade reversal (caused by imposing a wage floor) does not require the absence of monopoly power in trade, but always implies a decrease in welfare. Furthermore, when the home country instead exports the first good under wage-flexible free trade, the imposition of a wage floor cannot reverse the direction of trade (given a well-behaved foreign offer curve), as could easily be verified.

III. A SHIFT IN FOREIGN DEMAND

An increase in foreign import demand may raise or lower the home levels of employment and welfare, with the actual outcome depending upon the degree of specialization in home production and upon the direction of trade. The present possibility of welfare deterioration contrasts with the necessary welfare improvement in the standard full-employment model.

When the home country is incompletely specialized, an increase in foreign import demand will lower (raise) the home levels of employment and welfare if good two (one) is the home importable, as will now be shown. Suppose that the equilibrium is initially at S in Figure 4, and that the foreign offer curve then shifts out from OF (its initial position) to

OF'. At constant prices (p') and constant home employment, this shift in foreign demand creates a world excess demand for the labour-intensive second commodity (represented by line segment SS'). This excess demand is cleared, at constant prices (p'), as home producers increase their export offer (from S to S') by expanding output of good two (upwards along R_2R_1 in Figure 3) without loss of profit. As the home country moves from S to the new equilibrium S' (and moves correspondingly, in Figure 3, up R_2R_1 and r_2r_1), the home equilibrium levels of employment, income and welfare all increase. On the other hand, when the home country exports the capital-intensive first commodity, an increased foreign demand for imports creates a world excess supply of the labour-intensive second commodity (at constant prices and constant employment), and leads to a home deterioration in both employment and welfare.

If the home country is completely specialized, an increase in foreign demand for imports always improves welfare, and leads to an increase (no change) in employment when good two (one) is the home importable, as will now be shown. With the home country completely specialized and exporting the first commodity, an increase in foreign import demand will create, at constant prices and constant home employment, a world excess demand for good one. This excess demand is cleared partly by a rise in the relative price of good one, and partly by an increase in the level of home employment and output (since now these quantities increase with 1/p), as the home country moves rightward along A_1U_1 to a higher level of employment and welfare. Similarly, if the home country exports good two under complete specialization, an increased foreign demand for imports raises welfare

(because of the terms-of-trade improvement), but leaves the level of employment constant (since now this quantity does not vary with p).

It is interesting that a world excess demand for the capital-intensive first commodity leads to a rise in employment under complete specialization in that good, but leads to a fall in employment under incomplete specialization. In both cases, output of the capital-intensive commodity increases in response to the rise in demand. This increased output must, under complete specialization, result from a rise in total employment of labour, since there are no resources to be drawn from the (non-operating) labour-intensive industry. But when both goods are being produced, the increase in production of the capital-intensive industry is the result of drawing both labour and capital from the labour-intensive industry. Some of this labour released from the labour-intensive industry must flow into the pool of unemployed, since the constant factor proportions (along R_2R_1 in Figure 3) are unequal between industries.

IV. TARIFF CHANGES

This part discusses the comparative statics of changes in tariffs. First, Section A develops the necessary analytic background by examining the implications of tariff changes for the transformation curve, the consumption curve, and the offer curve. Then, Section B considers how changes in tariffs affect resource allocation, output levels, overall employment, terms of trade, and social welfare.

Since an <u>ad valorem</u> tariff on imports has the same effect as an equal <u>ad valorem</u> tariff on exports (according to Lerner's Symmetry Theorem [13]

which may be invoked under the assumptions made below), the following analysis applies to both of these trade taxes. Also, it is unnecessary to give a separate analysis of trade subsidies (on either imports or exports), since these may be viewed simply as negative tariffs.

A. Production, Consumption, and the Offer

Let the ad valorem tariff be denoted by t, where $t > 0$. (For a trade subsidy, $-1 < t < 0$.) Then the relationship between the domestic relative price of good two, still denoted by p, and the world relative price of good two, now denoted by π (whose value is to be determined by demand and supply in world commodity markets), may be written generally as

$$p = \pi/(1 + t)$$

when the home import is commodity one, or

$$p = \pi(1 + t)$$

when the home import is commodity two.

Since domestic producers and consumers respond directly only to domestic prices, a tariff does not affect the equilibrium relationship between the domestic product-price ratio (p) and factor rewards. Thus, there is no change in the equilibrium relationship between p on the one hand and the levels of employment and output on the other. In other words, the transformation curve is always (with or without a tariff) $R_2R_1T_1$ in Figure 6 (which reproduces $R_2R_1T_1$ and r_2r_1 from Figure 3), with each point on $R_2R_1T_1$ always corresponding to a unique value of p (which is the same with or without a tariff) and a unique level of employment (which is the same with or without a tariff).

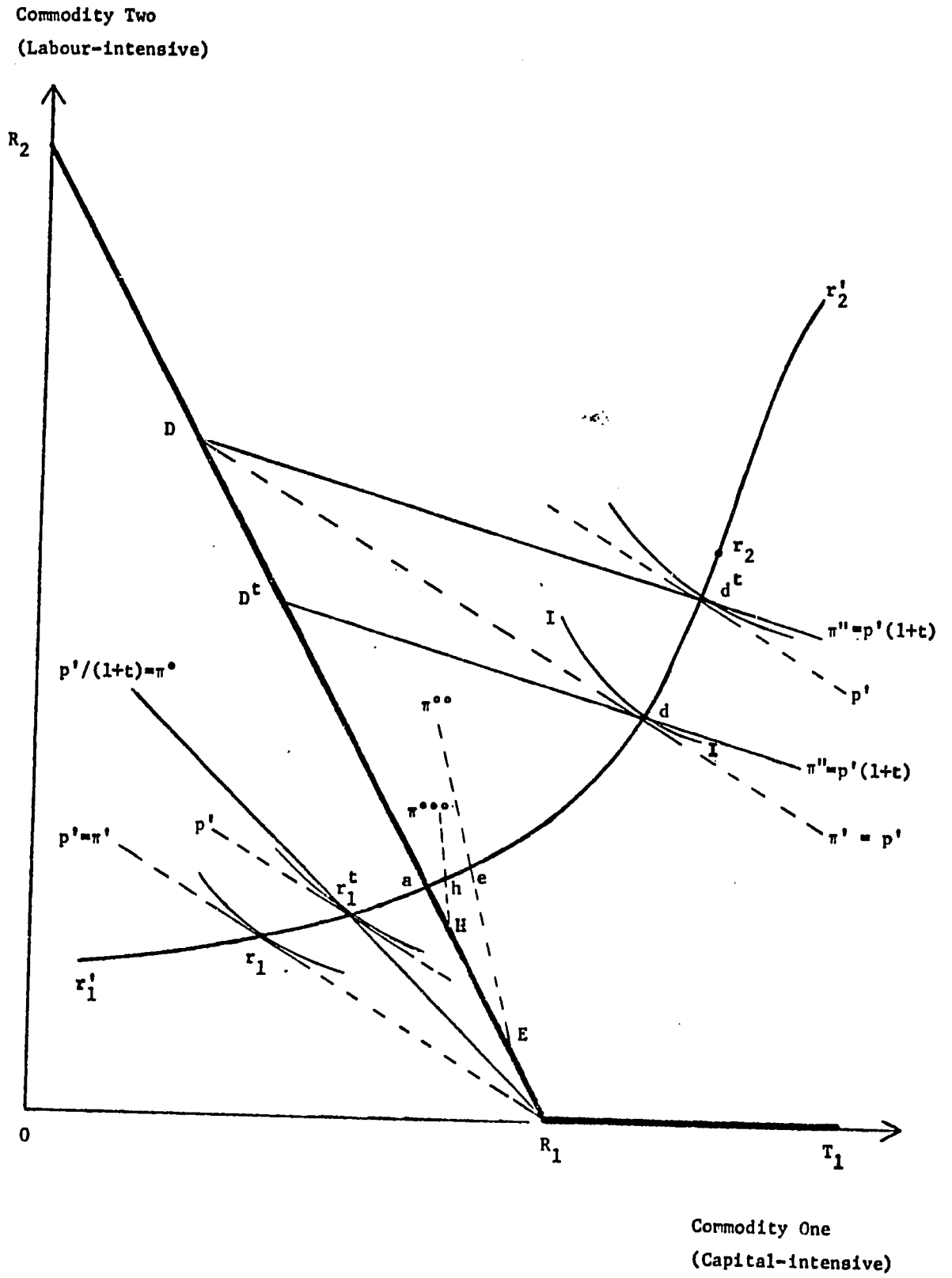
Commodity Two
(Labour-intensive)
R_2
r_2'
D
r_2
d^t
D^t
I
$\pi''=p'(1+t)$
$p'/(1+t)=\pi^*$
p'
π^{**}
d
I
$\pi''=p'(1+t)$
π^{***}
$\pi'=p'$
$p'=\pi'$
p'
r_1^t
a
h
e
H
r_1
r_1'
E
0
R_1
T_1
Commodity One
(Capital-intensive)

Figure 6

The home country's budget line through each production point has a slope of $-1/\pi$ that, given the tariff, diverges from $-1/p$ which was the slope before the tariff. Assuming that the tariff revenues are redistributed to consumers as lump-sum transfers (and, in the case of trade subsidies, that these subsidies are raised from consumers in lump-sum fashion), consumption takes place along each budget line at the point where the indifference curve cutting that line has a slope of $-1/p'$. For example, consider home production at point D $[R_1]$ in Figure 6: the corresponding equilibrium domestic price ratio is p' whether or not there is a tariff, according to the previous discussion of the transformation curve; in free trade, the corresponding equilibrium world price ratio would also be $\pi' = p'$, and consumption would be at d $[r_1]$; but given a tariff of rate t, the corresponding equilibrium world price ratio is $\pi'' = p'(1 + t)$ $[\pi^{\circ} = p'/(1 + t)]$ and consumption is at d^t $[r_1^t]$. Thus, when both goods are produced at home, consumption is always (with or without a tariff or trade subsidy) restricted to lie on the Engel curve for p', namely $r_2'r_1'$ (whose segment r_2r_1 is the free-trade consumption curve for incomplete specialization in production).[23] Consumption for the case of complete specialization in production could be illustrated similarly.

In Figure 7 (which reproduces $U_2A_2A_1U_1$ from Figure 4), the tariff-inclusive offer curve is $U_2^tA_2^tOA_1^tU_1^t$--assuming that the same tariff is imposed on imports (or exports) of <u>both</u> goods, no matter what the direction of trade.[24] At world price ratio $\pi'' = p'(1 + t)$, the home offer can be at any point on OA_2^t; which corresponds in Figure 6 to production along aR_2 and consumption along ar_2', at domestic price ratio p'. Similarly, at world

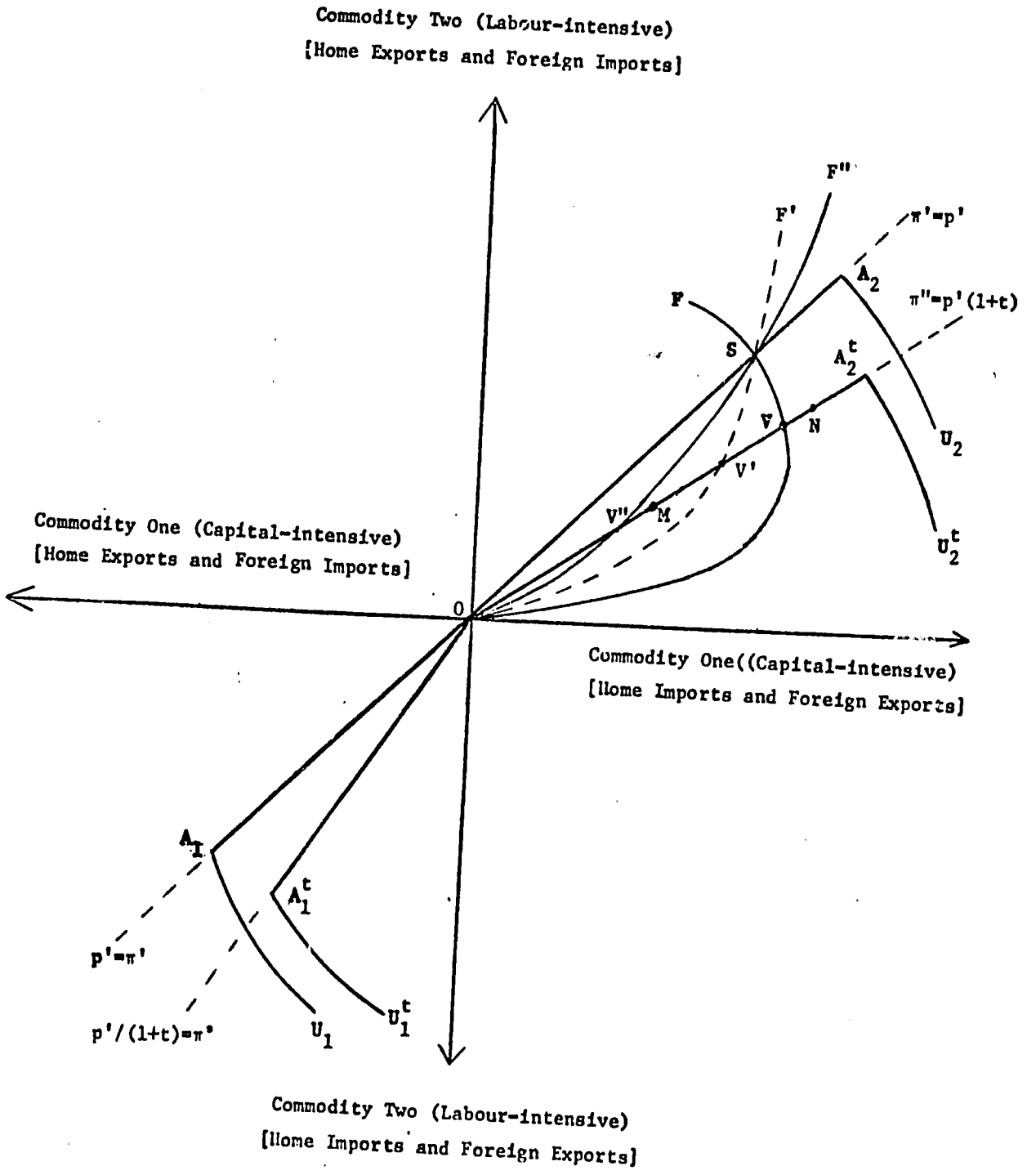
Commodity Two (Labour-intensive)
[Home Exports and Foreign Imports]
F''
F'
π'=p'
A2
π''=p'(1+t)
F
S
A2t
V
N
U2
V'
V''
M
U2t
Commodity One (Capital-intensive)
[Home Exports and Foreign Imports]
0
Commodity One((Capital-intensive)
[Home Imports and Foreign Exports]
A1
A1t
p'=π'
p'/(1+t)=π'
U1
U1t
Commodity Two (Labour-intensive)
[Home Imports and Foreign Exports]

Figure 7

price ratio $\pi^\circ = p'(1 + t)$, the home offer can be at any point on OA_1^t; which corresponds in Figure 6 to production along aR_1 and consumption along ar_1', at domestic price ratio p'. The segment $A_2^tU_2^t$ lies below A_2U_2 since, with specialization complete in good two, imposition of a tariff reduces the offer at every π according to the following argument: production remains constant (at the R_2 level in Figure 6); and it is well known in the full-employment literature that, at constant output, a tariff reduces the offer at every π. Similarly, $A_1^tU_1^t$ lies above A_1U_1 since, with specialization complete in good one, imposition of a tariff reduces the offer at every π according to the following argument: as just shown, even at constant output the tariff would reduce the offer at every π; but in addition, because the tariff decreases $1/p$ at each π, output and income fall (as the economy moves leftwards along R_1T_1 in Figure 6), so that the offer declines still further (in the absence of inferior goods). (In the case of a trade subsidy, in Figure 7: OA_2^t would be steeper than OA_2; OA_1^t would be flatter than OA_1; $A_2^tU_2^t$ would lie above A_2U_2; and $A_1^tU_1^t$ would lie below A_1U_1.)

B. Comparative Statics

The following preliminary comments indicate the nature of the propositions to be discussed. The signs of the employment response and of the output response to a tariff depend upon the relative factor intensity of the home importable, upon the degree of specialization in home production (i.e., incomplete versus complete), and upon whether or not the particular situation satisfies the Metzler Condition (which is the well-known condition for the occurrence of the Metzler Paradox in the standard full-employment model).[25] A tariff's effect on welfare does not necessarily have the same sign as the

tariff's effect on employment. Welfare may deteriorate unless the foreign offer curve is inelastic, as in the standard full-employment case.[26] When the home country has monopoly power in trade, optimal trade intervention (not a first-best solution in the absence of complementary policy) is not necessarily a tariff but may instead be a trade subsidy or simply free trade, in contrast to the standard full-employment case in which an optimal tariff is always the first-best commercial policy. When the home country has no monopoly power in trade, a tariff or a trade subsidy may be superior to the policy of free trade, even though this possibility would not occur in the standard full-employment model. All tariffs are assumed to be non-prohibitive unless otherwise stated, since the earlier comparison of free trade and autarchy (Section B of Part II) takes care of the analysis of prohibitive tariffs.

i. Incomplete Specialization

It is assumed in this sub-section that the home country is always incompletely specialized, both before and after the tariff change.

First consider the case in which the home importable is the capital-intensive first commodity. In Figure 7, with OF as the foreign offer curve, the imposition of a tariff shifts the world equilibrium from point S to point V. (Having free trade in the initial equilibrium position is diagramatically convenient, but is not required for any of the following discussion.) Although the tariff increase leaves the domestic price ratio constant at level p', it raises the world price ratio from level $\pi' = p'$ to $\pi'' = p'(1 + t)$, representing an improvement in the home country's terms

of trade. (Whenever $p \neq \pi$, the expression "terms of trade" will refer always to world, not domestic, prices.)

To determine the change in employment, first consider the world excess demands and supplies that the above tariff change would create at constant employment and corresponding prices (p' and π''). It is well known in the standard full-employment literature that, when the Metzler Condition is not met, this tariff increase--at constant domestic prices (p'), but increased world prices (π'')--will create a world excess demand for the home importable (good one). (It is this world excess demand for the home importable that, in the standard full-employment model, will raise the domestic relative price of the home importable, and hence increase output of that good but decrease the real wage--the outcomes associated with the absence of the Metzler Paradox.) This world excess demand for the home importable may be represented in Figure 7 by the line segment VN: where V is the foreign offer at world prices π''; and N (some point on OA_2^t above V) is the home offer at constant employment, constant domestic prices p', but increased world prices π''. This excess demand is eliminated, at constant prices, as the home country moves down OA_2^t from N to V, and correspondingly moves down R_2R_1 in Figure 6. These downward movements are achieved, as will be recalled, by an increase in output of the capital-intensive first commodity (which is the home importable) and a decrease in employment. Thus, when the Metzler Condition is not met: the protective effect of a tariff is normal (as in the full-employment case), in the sense that output of the home importable increases; and employment declines. By similar reasoning, when the Metzler Condition is met: the protective effect of a tariff is perverse (as in the full-employment case), in the sense that output of the

home importable decreases or remains constant; and employment increases or remains constant, respectively.

By similar reasoning, the following two propositions hold when the labour-intensive second commodity is the home importable. First, as the Metzler Condition is not met or is met, the tariff will have a normal or perverse protective effect (as in the full-employment case), and employment will increase or fail to increase (i.e., decrease or remain constant), respectively. Observe that the employment response, for both the normal case and the perverse case, is now opposite in sign to the response that occurred when good one was the importable. This difference arises because a normal (perverse) increase (decrease or constancy) in output of the home importable involves increased (decreased or constant) employment if this importable is labour-intensive, but involves decreased (increased or constant) employment if this importable is capital-intensive. Second, as before, raising a tariff improves the home terms of trade (now by raising $1/\pi$) and leaves the domestic price ratio constant (at p').

To examine welfare variations, first suppose that commodity one is the home importable. When the foreign offer curve is inelastic, a tariff must always improve home welfare (even though employment will decrease unless the Metzler Condition is met), as will now be shown. Assuming that the foreign offer curve (OF in Figure 7) is inelastic, the deterioration in the foreign country's equilibrium terms of trade (from $1/\pi'$ to $1/\pi''$) must increase both foreign exports and (because trade is balanced) home imports. Therefore, the final equilibrium (V) must lie east of the initial equilibrium (S). However, at constant home welfare (say indifference level I-I in Figure 6) and

corresponding prices ($p = p'$ and $\pi = \pi''$), home consumption would remain constant (at d in Figure 6) while home production of importables would increase (from D to D^t in Figure 6), in which case the home imports would decrease to some point like M (Figure 7) that lies west of the initial equilibrium (S in Figure 7). Thus, a tariff, at constant home welfare and corresponding prices, will create a world excess demand for labour-intensive commodity two, represented in Figure 7 by the line segment MV. Home welfare must then increase above the initial level as the home country eliminates this world excess demand at constant prices (by moving from M to V in Figure 7, and by moving correspondingly in Figure 6 from D^t and d upwards along D^tR_2 and dr_2').

When the foreign offer curve is instead elastic (in which case employment must decrease since the Metzler Condition cannot be met), the impact of a tariff on welfare is ambiguous, with a negative employment effect to be weighed against a positive terms-of-trade effect. For example, if the elastic foreign offer curve is OF' (OF") in Figure 7, then at constant home welfare and corresponding prices, a tariff creates a world excess supply of commodity two (one), represented by MV' (MV"). In this example, by previous reasoning, home welfare decreases (increases) from its initial level as the home country eliminates this excess demand by moving from M to the equilibrium point V' (V"). If the foreign offer curve is elastic throughout the relevant range, it may be impossible to find a tariff that raises welfare above the free-trade level. In other words, in some cases, tariff-restricted trade may be unambiguously inferior to free trade.

Next, suppose that the home country imports the second commodity (instead of the first). By similar reasoning (i.e., by once again considering the

world excess demands and supplies created, at constant home welfare and corresponding prices, by raising a tariff), the following two propositions hold. First, welfare deterioration in the event of raising a tariff still requires an elastic foreign offer curve, and therefore now implies an increase in employment (since the Metzler Condition cannot be met when the foreign offer curve is elastic). This possibility of a decrease in welfare, despite an improvement in both home employment and the home terms of trade, is now illustrated in Figure 6. In the initial equilibrium: the home terms of trade are $1/\pi^{\circ\circ}$ ($> 1/\pi'$), implying an initial tariff (since the initial terms of trade, $1/\pi^{\circ\circ}$, exceed the free-trade terms of trade, $1/\pi'$); home production is at E; and home consumption is at e. After the tariff increase: the home terms of trade are at an improved level, $1/\pi^{\circ\circ\circ}$; home production is at increased-employment level, H; and home consumption is at a reduced-welfare level, h. In this example, since the home budget line (at world prices) is steeper than the transformation curve (R_2R_1), an increase in employment upward along the transformation curve has (ceteris paribus) a negative impact on welfare by decreasing the value of national income at any given set of world prices. As a second proposition, any tariff (trade subsidy) imposed under free trade must now drive welfare above (below) the free-trade level. In other words, tariff-restricted trade is unambiguously superior to free trade (and to subsidy-expanded trade in the same direction as free trade). This proposition and the previous one together imply that a tariff increase may reduce welfare only if the initial equilibrium is tariff-restricted.

On the basis of the foregoing results, a few comments are now offered on optimal trade intervention--assuming both the absence of complementary

commercial policy and the maintenance of incomplete specialization (ignoring the possibility that the home country might do even better by using trade policy to achieve complete specialization). In the first place, optimal trade intervention is not by itself a first-best policy, since the latter requires DRS = DRT = FRT (see Bhagwati and Ramaswami [5]) while the former leaves DRS < DRT: where DRS is the domestic rate of substitution (in consumption), given by (minus) the slope of the community indifference curve (Figure 6), and equals the constant 1/p' in equilibrium as will be recalled; DRT is the domestic rate of transformation (in production), given by (minus) the constant slope of R_2R_1 (Figure 6), and exceeds 1/p' (=DRS) as will be recalled; and FRT is the foreign rate of transformation (through trade), given by the slope of the foreign offer curve (Figure 7). More specifically, optimal trade intervention occurs at the point on the foreign offer curve where DRS < DRT = FRT, as shown by Brecher ([6], Chapter IX where, by use of the well-known Baldwin [1] technique, the optimal trade policy is derived and placed in a welfare ranking along with alternative policy packages). Since (as will be recalled) raising a tariff always improves home welfare when the foreign offer curve is inelastic, the latter must be elastic at the point of optimal trade intervention. When the home country imports the first commodity under free trade, optimal trade intervention could require a trade subsidy (or simply free trade) rather than a tariff, since (as will be recalled) tariff-restricted trade in some cases may be unambiguously inferior to free trade. (The case of an optimal trade subsidy and the case of an optimal tariff are both illustrated by Brecher [6], Chapter IX.) But when the home country imports

the second commodity under free trade, optimal trade intervention always requires a tariff (perhaps a prohibitive one in combination with a trade subsidy to reverse the direction of trade, as shown by Brecher [6] in Chapter IX), since (as will be recalled) tariff restricted trade is always unambiguously superior to free trade (and to subsidy-expanded trade in the same direction as free trade).

If, by coincidence, the foreign offer curve is perfectly elastic at price ratio $\pi' = p'$, then any home tariff is prohibitive,[27] since the tariff-inclusive offer curve ($U_2^tA_2^tOA_1^tU_1^t$ in Figure 7) will in this case intersect the foreign offer curve only at the autarchy point (0).[28] Recalling the earlier comparison of free trade with autarchy (Section B of Part II), a tariff will decrease or increase employment and welfare as the home country imports good one or good two under free trade, respectively. This possibility of welfare improvement does not exist in the standard full-employment model, in which (as a well-known proposition) the optimum tariff is zero when the home country has no monopoly power in trade.

ii. Complete Specialization

When the home country produces only commodity two, both before and after the tariff increase, equilibrium in Figure 7 occurs first on A_2U_2 and then on $A_2^tU_2^t$. Drawing in the foreign offer curve (not shown) would indicate an improvement in the home terms of trade. Employment and output, however, are constant at the R_2 level (Figure 6), according to the earlier discussed relationship between the offer curve and the transformation curve. The welfare propositions of the standard full-employment case clearly carry over to the present constant-employment case.

When home specialization is complete in good one and the foreign offer curve is perfectly elastic, a tariff increase will raise p and therefore reduce employment (since 1/p and employment decrease together), moving the economy leftwards along P_1T_1 in Figure 5. In this case, a tariff will clearly reduce welfare since there is no terms-of-trade improvement to counter the fall in employment and output. On the other hand, a trade subsidy will raise employment and may raise welfare if the consumption distortion (due to a divergence between p and π) does not outweigh the employment gain.[30] The case of a prohibitive tariff is an exception to the proposition that a tariff necessarily reduces welfare when world prices are given, since (as will be recalled from Section B of Part II) autarchy may be superior to free trade.[31] Thus, when the home country has monopoly power in trade, a zero trade tax is not necessarily optimal- in contrast to the standard full-employment case in which, as a well-known proposition free trade is the first-best policy.

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FOOTNOTES

[1]Brecher's [6] discussion includes: a description of the general method, in Chapter III and its mathematical appendix; the efeccts of an increase in the stock of capital, in Chapter V and its mathematical appendix; the impact of a technical change in either industry, in Chapters VI and VII and their mathematical appendices; and the effects of tax-cum-subsidies on production and on factor use, in Chapter IX in the context of optimal commercial policy.

[1a]Introducing factor-intensity reversals would simply complicate the exposition, without adding much insight in the present context.

[2]To avoid welfare complications of "voluntary" unemployment in which an individual is out of work because he values an hour of leisure more than the going wage, it is assumed that the wage floor is set institutionally--and not set by individual preferences concerning leisure and income.

[3]As Johnson [9] has pointed out, a wage that is rigid in money terms but not in real terms need not lead to unemployment in the standard barter model of international trade.

[4]A minimum real wage imposed in only one sector would not lead to ("open") unemployment (of the type discussed here) but, as shown by Johnson [10], could instead result in inefficient production (at points not on the conventional contract curve).

[5]Recall footnote 2.

[6]The unemployed labour may be thought of as a pool, into which labour flows at any sub-minimum wage, and out of which labour flows (attempting to bid down the market wage) at any above-minimum wage. Seen in this way, the present situation is analytically similar to Mundell's ([16], Chapter 6) case of international factor mobility (when the latter is modified so that labour, not capital, is the internationally mobile factor). In Mundell's case, the minimum (and maximum) home wage is given by the wage available abroad, and the foreign labour market is a pool to or from which labour flows as the home wage falls below or rises above the foreign wage, respectively. There are, however, two important differences. First, in Mundell's case, the flows of labour to and from the pool shift the foreign offer curve; whereas, in the present model, labour flows are purely domestic and leave foreign demand unaffected. Second, in Mundell's case, a flow of labour to the pool means merely a change in the location of employment; whereas, in the present model, a flow of labour to the pool means unemployment.

[7]Bhagwati [2] discusses variations in the overall employment level of capital, not labour. Assuming that he actually has in mind a rigid return to capital and a perfectly flexible wage--not the rigid wage and perfectly flexible return to capital that he in fact assumes--his results and the corresponding present results (reported mainly in Section B of Part II) are in basic agreement, making obvious allowance for the fact that the rigid factor reward is then different in each case.

[8]According to this price relationship: under incomplete specialization there is a one-to-one correspondence, independent of total employment levels, between the product-price ratio and (relative and absolute) factor rewards.

[9]According to this theorem: under incomplete specialization a decrease in total labour employment, at constant relative product prices and constant total utilization of capital, will decrease output of the labour-intensive good and increase output of the capital-intensive good.

[10]Proof that the Rybczynski line is straight may be found in Mundell ([16], Chapter 6, page 93, for the analogous case where total capital is varied with total labour constant), and in Brecher ([6], Chapter I, footnote 5).

[11]According to this theorem: under incomplete specialization a fall in the relative price of a commodity lowers the reward (in terms of both goods) of the factor used intensively in that commodity, and raises the other factor's reward (in terms of both goods).

[12]The impossibility of complete specialization in commodity two may also be seen geometrically as an immediate consequence of the following proposition (to be proven momentarily): the budget line for any $p < p^\circ$ (say p'') is steeper than the production-possibility frontier at each point on OT_2, thereby indicating that profits cannot be maximized when only good two is produced. This proposition is clearly true at T_2. Therefore, it is also true at all other points on OT_2, since (by a well-known corollary of the Rybczynski Theorem [17] the production-possibility frontier becomes flatter along every ray from the origin (including the vertical axis) as total labour employment is decreased (holding total utilization of capital constant).

[13]Point B must lie to the left of the lower endpoint of the undrawn Rybczynski line for p'', since at this endpoint (as at all points on this line) the profit-maximizing wage is sub-minimal. (Rybczynski lines for different values of p cannot intersect, as explained in footnote 15 below, so that the undrawn Rybczynski line for p'' must lie completely to the right of $R_2^\circ B_1^\circ$). Furthermore, point B satisfies the (corner) condition of profit maximization, as could be shown easily by reasoning similar to footnote 12.

[14]Also, the economy cannot specialize completely in the first commodity at the point on OT_1 where labour's wage (and marginal product) equals the minimum, since the (corner) condition of profit maximization cannot be met at this point as could be shown easily by reasoning similar to footnote 12.

[15]Rybczynski lines for different product-price ratios cannot intersect (as implied by Figure 1), since any point of intersection would have to lie on two intersecting production-possibility frontiers--a contradiction, because varying total labour employment (with total utilization of capital held constant) yields only non-intersecting production-possibility frontiers.

[16]For an independent discussion of the transformation curve (with the minimum wage specified in terms of one good), in a somewhat different context, see Lefeber [12].

[17]There are other ways of deleting a full-employment segment like $T_2R_2^\circ$ from the transformation curve. For example, this deletion would be achieved (while holding the minimum wage constant at the R_2° level) if the labour endowment were increased sufficiently, so that the new full-employment production-possibility frontier (not shown) lay entirely above $R_2^\circ R_1^\circ$ extended to the vertical axis. The deletion could also be achieved by a sufficient decrease in the stock of capital. In general, the full-employment (conventional) production-possibility frontier lies entirely above the Rybczynski line for the minimum wage if and only if industry two's labour/capital employment ratio along this Rybczynski line is less than the given labour/capital endowment ratio.

[18]Therefore, ignoring point T_1, this situation is analytically equivalent to Bhagwati's [2] case in which the actual (not the minimum) wage is fixed in terms of one good.

[19]The minimum wage could be respecified in terms of good one (instead of good two), say (for diagrammatic convenience only) at the level defined by the first industry's marginal product of labour along R_2R_1. In this case, the transformation curve would be $T_2R_2R_1$: R_2R_1 for $p = p'$; T_2R_2 for all $p > p'$, with employment and output increasing as p rises; and R_1 for all $p < p'$.

Alternatively, the minimum wage could be respecified in terms of a constant-utility combination of both goods, as defined by an institutionally chosen indifference curve. In this case, there would be exactly one p and associated Rybczynski line, say (for diagrammatic convenience only) p' and R_2R_1, whose corresponding profit-maximizing wage just satisfied the minimum-utility constraint--i.e., given p' and the corresponding profit-maximizing wage, the labourer's budget line would be tangent to the minimum indifference curve. Then, the transformation curve would be $T_2R_2R_1T_1$, combining

the features of the other two minimum-wage specifications. Each point on R_2T_2 (R_1T_1 excluding point R_1) would in general correspond to a higher (lower) p than if the minimum wage were specified in terms of good one (two)--although this price difference might disappear if the minimum indifference curve were a straight line.

To take account of these changes in the transformation curve that would result from respecifying the minimum wage in terms of good one or a constant-utuility combination of both goods, the following analysis could easily be modified (as shown by Brecher [6]).

[20] Inferiority can lead to problems of multiple equilibria and instability in only the following two cases: sufficiently strong inferiority of the capital-intensive first commodity under incomplete specialization in production, leading to multiple equilibria and instability for the level of home employment, but not for world offers; and sufficiently strong inferiority of the home importable under complete specialization in production, leading to multiple equilibria and instability in world commodity markets and in the home labour market. Some further comments on this point may be found in Brecher ([6], footnote 14 of Chapter I, and footnote 19 of Chapter II).

[21] Multiple intersections would not result from inferiority of commodity two.

[22] Bhagwati [2], Haberler [8] and Johnson [9] have also demonstrated ambiguity in the comparison of free trade with autarchy--for the case where world prices are given, so that (assuming the free-trade and home autarchic price ratios are not equal) free trade leads to complete specialization (when there is no domestic immobility of factors).

[23] For any trade tax (subsidy) of rate $t > 0$ ($0 > t > -1$), all possible consumption equilibria on $r_2'r_1'$ lie above (below) point r_1 (r_2), since the world-price budget line through point R_1 (R_2) is steeper under a trade tax (subsidy) than under free trade.

[24] If the tariff were imposed only on imports of good one (two), or only on exports of good two (one), then the tariff-inclusive offer curve would be $U_2^tA_2^tOA_1U_1$ ($U_2A_2OA_1^tU_1^t$).

[25] In the standard full-employment literature, the Metzler Paradox [15] is the case in which raising a tariff lowers or leaves constant the domestic relative price of the home importable, so that (under incomplete specialization) the tariff's protective effect is perverse (in the sense that output of the home importable decreases or is constant respectively). A general statement of the Metzler Condition, satisfaction of which ensures the Metzler Paradox (assuming stability in world commodity markets), may be found (for the case of "small" tariff changes) in Kemp ([11], condition (4.4), page 96). It suffices here to say that, for the Metzler Condition to hold (and hence for

the Metzler Paradox to occur in the standard full-employment case), an inelastic foreign offer curve is necessary (assuming no inferiority in home consumption) but is not sufficient.

[26] Exceptions to this proposition in the standard full-employment model are ruled out by the present assumption that neither good is inferior. For these exceptions when the home exportable is inferior, see Kemp ([11], pages 306-310).

[27] The prohibitive nature of a home tariff in the present minimum-wage model is analytically similar to a tariff's prohibitive effect in Mundell's ([16], Chapter 6) model of international factor mobility. In Mundell's case, equilibrium requires that the domestic product-price ratio be the same in both countries (in order to equalize factor rewards internationally)--impossible under tariff-restricted trade. In the present minimum-wage case, equilibrium requires only that $p = p'$ in the home country (so that the profit-maximizing wage equals the minimum and labour ceases to flow to or from the pool of unemployed)--impossible under tariff-restricted trade if the foreign offer curve is infinitely elastic at $\pi' = p'$, but possible if the foreign offer curve is less than infinitely elastic.

[28] If the assumption of footnote 24 were made, a tariff could reverse the direction of trade instead of leading to autarchy although the following employment and welfare conclusions would still hold.

[29] Things are now slightly more complicated, since the value of p corresponding to a given level of welfare increases as the tariff is raised, as could easily be verified.

[30] A great enough trade subsidy will achieve full-employment production at point T_1 in Figure 6. Incidentally, T_1 can also be reached by a production tax-cum-subsidy in favour of good one and, since no consumption distortion occurs, this policy is superior to the trade subsidy that also leads to T_1. Furthermore (as shown by Brecher [6], Chapter IX), the production tax-cum-subsidy may even be a first-best policy.

[31] Bhagwati's [2] demonstration that a tariff may improve welfare is an example of the case of a tariff which leads to autarchy. A tax-cum-subsidy in production that also leads to autarchy is no better than a prohibitive tariff, since the usual added consumption distortion of a tariff does not apply in autarchy.

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