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Unequal Exchange: Theoretical Issues and Empirical Findings

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ABSTRACT: Recent critics of unequal exchange have argued that not only does the theory critically depend upon the unrealistic assumption of complete specialization (no nonspecific commodities) but also that unequal exchange tends to be self-cancelling and empirically insignificant. Each of these criticisms is examined and found to be lacking. The theory is first extricated from the confusing and irrelevant environment of the labor theory of value and a price-denominated fundamental theorem is stated and proved. Unequal exchange is then generalized to account for nonspecifics in a logically consistent way. Though the fundamental theorem does not hold for nonspecifics, a numerical example in which surplus *is* transferred shows that any criticism of unequal exchange based on its alleged inability to handle nonspecifics must be empirical in nature rather than logical. It is next shown that while unequal exchange may indeed disappear in the long run for a variety of reasons, nothing in the theory itself implies that it is *necessarily* self-cancelling. It is argued that capitalists are not attracted to the periphery by low wages but by high profits which depend upon transportation costs and nontraded goods as much as low wages. Finally a 67-sector model of world trade is introduced in an attempt to assess the empirical relevance of unequal exchange. It is shown that some 38% of the value of peripheral exports is required to equalize the rate of profit under existing wage differentials.

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In a recent contribution to this journal[1] de Janvry and Kramer examine the theory of unequal exchange and identify what appear to be some rather serious deficiencies. Specifically, they argue that 1) Emmanuel's thesis of the "imperialism of free trade" is only valid under the highly restrictive conditions of complete specialization (specific commodities); 2) whether complete specialization obtains or not, initial wage disparities tend to disappear in long-run equilibrium; and 3) the restrictive condition of complete specialization effectively deprives the concept of unequal exchange of any empirical significance. De Janvry and Kramer conclude that the theory of unequal exchange cannot, therefore, serve as a basis for a general theory of underdevelopment.

In this paper I object to each of these criticisms. Properly reformulated to remove its dependence upon the labor theory of value, the theory of unequal exchange can indeed survive the introduction of nonspecific commodities. I develop a simple model in which both center and periphery produce the same commodity and show that even under conditions of incomplete specialization, value can still be transferred from periphery to center via unequal exchange. The second criticism, that unequal exchange is necessarily self-cancelling over time is then considered. Unequal exchange depends upon the equalization of the rate of profit and thus the assumption that capital is internationally mobile. Capital mobility, however, does *not* imply that investment continually flows from rich to poor countries until the reserve armies of the latter are exhausted. If prices adjust such that an "unequal exchange equilibrium" exists (i.e., an equilibrium with unequal wage rates) then nothing in the model would necessarily imply a flow of investment funds from center to periphery and unequal exchange is *not* necessarily self-cancelling in the long run. Finally, the case against the "empirical significance" of Emmanuel's thesis is examined and found to be without founda-

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tion. I present a 67-sector model of world trade in which gains from unequal exchange are estimated for a representative import-export bundle traded between Peru and the U.S. in 1969. It is seen that some 38% of the value of exports is transferred due to unequal exchange. Scaled to the level of trade between center and periphery for 1969, this transfer amounts to some 10 billion U.S. dollars, a figure approximately equivalent in magnitude to the total transfer of public foreign resources to Third-World countries in the same year.

Unequal Exchange and the Labor Theory of Value[2]

Though the theory of unequal exchange was originally presented by Emmanuel as an extension of the Marxian transformation problem to the realm of international trade, his central propositions depend in no essential way on the validity of the labor theory of value. Contrary to the assertion that "the theoretical basis for unequal exchange has its roots in Marx's labor theory of value, "I would argue that it has served only to confuse readers trying to understand Emmanuel's work. Let us see why this is so.

Interpreted in terms of the transformation problem, the main body of the theory may be summarized as follows: to every exchange of commodities there corresponds not only an equivalent exchange of money value, but also an exchange of labor values, that is, the socially necessary labor embodied in those goods. Therefore, if prices of imports and exports are not proportional to their respective labor values by the same coefficients of proportionality, this latter exchange of labor values will be unequal.

Of course there are a number of reasons why world prices might not be proportional to labor values. As is well known, prices will generally diverge from values when the rate of profit is positive and the organic composition of capital differs from branch to branch. But the organic composition of capital is a complex entity, representing a number of different variables each of which is capable of changing more or less independently. One way to group these variables is to note that the organic composition of capital θ can be written as a function of the rate of exploitation $e = s/v$ (where s and v are surplus-value and variable capital respectively) and the *technical* composition of capital, $\tilde{\theta}$. The latter is defined as the ratio of constant capital to total living labor $v + s$ and is "technical" only in the sense that it is independent of variations in the proportion of paid to unpaid labor. On the basis of these definitions, we may write the organic composition of capital for the jth sector of an n-sector economy as:

$$\theta_j = (1+e_j)\tilde{\theta}_j \qquad (j = 1, 2, \ldots, n)$$

In the domestic transformation problem, the rate of surplus-value is assumed to be equalized across branches by competition among workers; no distinction between the technical and organic compositions of capital is then necessary since one is simply a constant fraction of the other. In making the transition to the international economy, however, the rate of surplus-value is no longer constant since labor is not sufficiently mobile across national boundaries to effect its equalization. This is true whether each country is assumed to specialize in one branch of production or if each branch is made up of an output-weighted average of countries in which the rate of surplus-value differs. In either case, the organic composition of capital fails to "mirror" changes in the technical composition due to assumed differences in the rate of exploitation from country to country.

The deviation of prices from their corresponding values therefore depends as much upon the sectoral variation in the proportion of paid to unpaid labor as differences in the technical composition of the means of production. Emmanuel refers to the entire variation between prices and values as "unequal exchange in the broad sense."[3] The deviation of prices from values due only to differences in the rate of surplus-value is referred to as unequal exchange in the "strict sense."[4] Emmanuel did not regard unequal exchange in the broad sense as a meaningful indicator of surplus transfer in trade since it presumably occurs in any productive system characterized by different technical combinations of the means of production. He wrote:

> When we say that there is unequal exchange between France and Guinea, we are not concerned with what would happen if capitalist production relations did not exist, and commodities were exchanged in accordance with their values and not their prices of production, but with what would happen if Guinea were a part of France, like Brittany or the *département* of Alpes Maritimes, that is, if the exchange we are analyzing were intranational instead of international. (Emmanuel 1972:161)

Unfortunately, separating the components of the flow of value into a part due to unequal technical compositions and a part caused by the inequality of the rate of surplus-value is no simple matter. One must first compute the total flow of value, equalize the rate of surplus-value and then show that the flow of value has been reduced by some amount. Only in this way can the flow of value owing to differences in the rate of surplus-value be netted out of the total price-value differential.

The case against the relevance of the labor theory of value to unequal exchange begins with the observation that changing the rate of surplus-value does not alter the labor values of commodities. This much is ob-

vious: the proportion of output appropriated by capitalists cannot affect the amount of socially necessary labor time embodied in goods. However, changing the rate of surplus-value definitely does affect prices. Hence, a comparison of price-value ratios under different assumptions about the rate of surplus-value is not really a comparison of prices and values, but rather a comparison of prices with prices: prices with equal wages and prices with existing wage differentials. "It thus becomes clear," Emmanuel wrote, "that the inequality of *wages* is alone the cause of unequal exchange." (Emmanuel 1972:61).

The fact that unequal exchange has nothing really to do with the labor theory of value is actually quite fortunate for several reasons: First, nothing prevents the center from selling its output below its value thereby transferring labor value to the periphery while at the same time extracting value from the periphery in price terms. Second, a transfer of value, if measured in labor time, is in general meaningless if commodities are exchanged at their prices of production. Let us consider these arguments in more detail.

Though it is *not* true in post-Bortkiewicz versions of the transformation problem, in Marx's system, branches whose organic composition of capital is greater than average sell their output at prices higher than its corresponding value.[5] But with unequal rates of surplus-value, the organic composition of capital can be the same in two branches, yet the price-value ratio may differ. Unequal rates of surplus-value can even reserve the relation such that a branch whose organic composition is *above* average may sell its output at a price *below* its value if the rate of surplus-value is sufficiently high relative to the average.

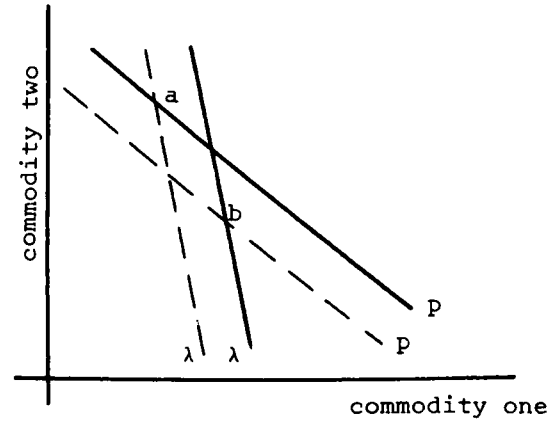
It is sometimes *assumed* (but never demonstrated) that central countries have a higher technical composition of capital than those of the periphery. But since wages are considerably higher, the *organic* composition of capital may well be lower in the center than the periphery. Emmanuel's original diagrams are constructed such that this is the case. (Emmanuel: 1972:62-3). But the flow of value from center to periphery implied by this lower organic composition is reversed by the low rate of exploitation in the center. Hence the perversity, that is, a transfer of value from center to periphery, does not surface. There exists of course no theoretical reason why the rate of surplus-value would be sufficiently low in the center to offset the lower organic composition. Indeed, casual empiricism would suggest that the transfer of technology to the periphery, expecially in the branches in which they tend to specialize, would combine with low wages to yield extraordinary high organic compositions of capital. Whether the lower rate of exploitation in the center is capable to offsetting these high organic compositions is strictly an empirical matter. If they do not, the center will export more value to the periphery than it receives in exchange.

A final point to note is that in general Marxian prices do not correspond to prices of production. The principal implication of this fact is that the relation of the organic composition of one branch to the general average (even when the rate of surplus-value is uniform) imparts no information in regard to the relation between the price and value of that sector's output. A high organic composition may be associated with a relatively low price-value ratio and vice-versa. While for post-Bortkiewicz transformation procedures it is still true that equal organic compositions imply the proportionality of prices to values, no apriori conclusions about the price-value ratio can be drawn from a knowledge of organic compositions.

These technical difficulties would be more worrisome were it not for the fact that an unequal exchange of labor values is in any event meaningless when commodities exchange at prices of production. If unequal exchange is limited to the case in which "the periphery gives more social value to the center than it receives . . ." it is unfortunately subject to a debilitating criticism of "so what?" As a theory of surplus transfer in trade, the ultimate objective of unequal exchange must be to explain unequal development. Hence, the beneficiaries of unequal exchange must in some sense find themselves better off as a result of the transfer of value. In precisely what sense the winners win and the losers lose, however, has more often than not escaped careful consideration in the discussion of this theory. Indeed, it may not even be possible to distinguish winners from losers without knowing in advance the ratios in which commodities exchange.

In figure one we examine a world in which there are only two countries and two commodities. The output of country one is represented by *a* and that of country two by *b*.

FIGURE 1:



The lines labelled P are drawn such that their slopes are equal to the negative of the ratio of world prices $(-p_1/p_2)$ while the slopes of the lines labelled λ are the ratios of values $(-\lambda_1/\lambda_2)$. Which country is to be identified as the center and which is the periphery depends upon whether commodities are exchanged at their prices or their values. If prices reign, country *a* is the center and *b* the periphery since country *a* could export commodity two and import commodity one until it had more of both goods. If commodities instead exchanged according to their embodied socially necessary labor time, country *b* would be rich and country *a* poor. What meaning then can an unequal exchange of labor values have once it is granted that a value-rich country may be quite easily price-poor, and, as long as world prices are prices and not values, poor in terms of command over real resources? If unequal exchange is to serve as an explanation for real unequal development, the surplus transferred in trade must be measured in price and not value terms.

It should now be evident that the technical and conceptual difficulties involved in using the labor theory of value in any rigorous specification of the theory of unequal exchange are so enormous that this approach should be scrapped in the name of clear thinking. This is especially evident in light of the clarity and elegance with which unequal exchange (at least in the strict sense) may be defined in the price realm. The reformulation in price terms does not obscure real issues which had surfaced in the earlier discussions of unequal exchange and possesses the additional advantage of indentifying some important problems buried in the transformation approach.

Unequal Exchange Without the Labor Theory of Value.

We begin with the simplest possible case of two commodities produced by two countries. Let country A be the high-wage center and B be the periphery in which wages are uniformly lower. Each country is technologically capable of producing both commodities but we do *not* assume that the technique (set of processes) is necessarily the same in both countries. In long-run equilibrium, the terms of trade can be shown to depend only upon the level of wages and technical coefficients in each country. The pattern of specialization will be determined endogenously. Let $A^k = (a^k_{ij})$ i, j = 1, 2, ..., n) be a matrix of technical coefficients describing the amount of commodity i used for the production of one unit of commodity j for country k. There are n commodities. $L^k = (\ell^k_j)$, (j = 1,2,..., n) is a row vector of direct labor requirements per unit of output. $P = (p_j)$ is a row vector of international prices and r_k is the domestic rate of profit. Let $C^k = (c^k_i)$ be a column vector of consumption coefficients for country k; the matrix $C\hat{L}$, where $\hat{L}$ is a square matrix with direct labor coefficients on the diagonal and zeros elsewhere, can then be added to A to form $\hat{A}$, the familiar "augmented" matrix of technical coefficients. That is, $\hat{A}^k = A^k + C^k\hat{L}^k$. There is no joint production, and hence no fixed capital, and wages of course are assumed to be paid in advance. The price of production equations can now be written:

$$P = (1 + r_k)P\hat{A}^k \qquad (k = 1,2,\ldots,m)$$

for each of the *m* countries of the world.

For the simple model in which there are only two countries and two goods, (n = m = 2), the price-determining equations may be written:

center

$$p = (1+r_A)(p\hat{a}^A_{11} + \hat{a}^A_{21})$$

$$1 = (1+r_A)(p\hat{a}^A_{12} + \hat{a}^A_{22})$$

periphery

$$p = (1+r_B)(p\hat{a}^B_{11} + \hat{a}^B_{12})$$

$$1 = (1+r_B)(p\hat{a}^B_{12} + \hat{a}^B_{22})$$

where commodity two is taken as numeraire, i.e., $p = p_1/p_2$.

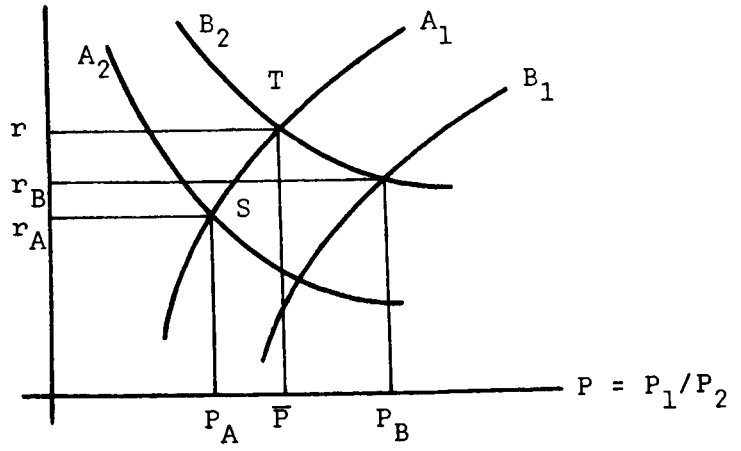
With wages taken as given for each country, these equations can be plotted in profit/terms of trade space as is done in figure 2.[6] The curve labelled A_1 represents the terms of trade-profit relation for commodity one in country A, the center. The remaining curves are labelled according to the same scheme. The autarkic rate of profit in A is determined by the intersection of A_1 and A_2 at S in the first frame; the profit rate r_A corresponds to the pretrade price ratio in A, p_A. The figure is drawn such that the autarkic rate of profit in B is higher than in A; the pretrade price ratio in B is also higher than in A.

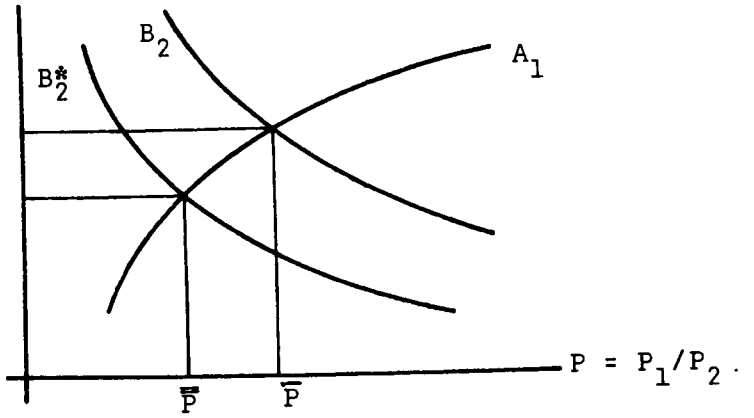
Given the technology and real wage configuration depicted in figure 2, profit-maximizing capitalists in both countries would tend to specialize. Since the relative price of the second commodity is cheaper in B, capitalists in A can make higher profits by importing commodity two from B rather than producing it domestically. Similarly, capitalists in B can earn higher profits by importing rather than producing the first good.

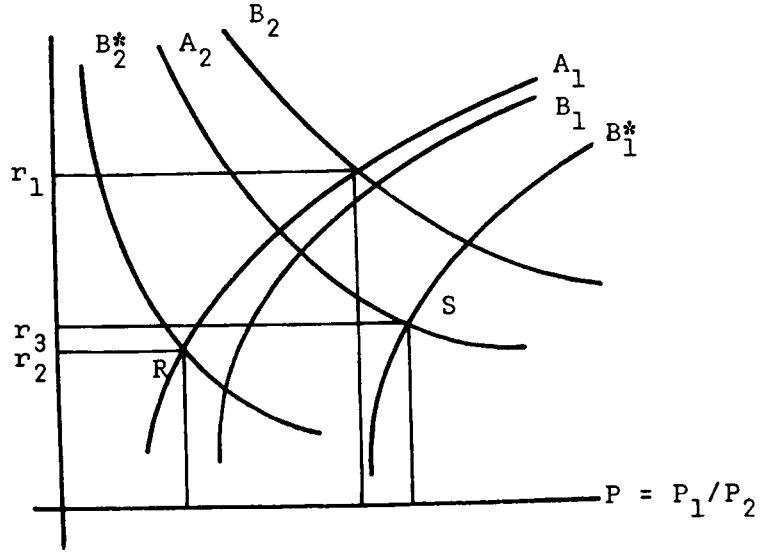
At point T in the first frame of figure 2, both countries have completely specialized: A produces the first commodity and B produces the second; the rate of profit has risen in both countries as a result of the specialization, and is now uniform. As we might expect, the equilibrium terms of trade, $\bar{p}$, fall between the autarkic price ratios p_A and p_B.

It is important to keep in mind that Emmanuel *be-*

FIGURE 2:


B2
A1
A2
T
B1
r
rB
rA
S
P = P1/P2
PA
P̄
PB


B2
A1
B2*
P = P1/P2
P̄
P̄


B2
B2*
A2
A1
B1
B1*
r1
S
r3
r2
R
P = P1/P2

gins his argument about unequal exchange at a point such as T. It is not a thesis about the opening of trade, the determination of the pattern of specialization or the formation of an internationally uniform rate of profit. Unequal exchange rather compares two sets of terms of trade under different assumptions about the level of wages in each country. The pattern of trade specialization is taken as historically determined and, at least in the simplest version of the theory, invariant with respect to changes in the level of wages.

We are now in position to illustrate the fundamental theorem of unequal exchange (proved in a more general context below) for the case of m = n = 2. As the wage rate in B rises, $\mathbf{B}_2$ shifts down to $\mathbf{B}_2^*$[7] as shown in the second frame of figure 2. The terms of trade for B improve and as long as wages are unequal, the terms of trade will continue to improve with further increases in the level of peripheral wages. If $\bar{\bar{p}}$ are the terms of trade with equal wages, $\bar{p} - \bar{\bar{p}}$ measures the flow of value per unit of exports from center to periphery. This flow of value is price denominated and therefore corresponds to a flow of real resources. Note however, that the flow of value is purely ordinal until the absolute value of the numeraire is specified; only then can we speak of a determinant amount of value transferred from periphery to center. Observe that the pattern of trade specialization can change with a change in the level of wages in the periphery. This case is illustrated in the third frame of figure 3. As wages in the periphery increase both $\mathbf{B}_1$ and $\mathbf{B}_2$ shift down to B_1^* and B_2^* respectively. The rate of profit falls as a result from r_1 to r_2. But at this lower profit rate, capitalists soon discover that they can increase their profits by reversing the pattern of specialization from R to S; the periphery now produces and exports good one while the center exports good two. The direction of movement of the terms of trade is as one might expect indeterminant. Whether p_1/p_2 increases, decreases or remains constant at S depends entirely upon the shape of the curves B_1^* and A_2, and the magnitude of the change in wages.

We conclude that in the simple case of two countries and two commodities with no trade pattern reversals, an increase in the wage rate in one country will improve its terms of trade. This fundamental theorem of unequal exchange will be stated and proved for a more general environment in the next section.

Generalizing to Many Commodities and Countries

A world in which there are more than two commodities and two countries poses fundamental problems for the theory of unequal exchange. If one country exports more than one commodity, it can no longer be asserted that an increase in wages in that country implies that the terms of trade for all its commodities will necessarily improve. Similarly, if two countries produce and export the same commodity, a rise in wages in one country need not lead to an improvement in its terms of trade. Fortunately, the theory of unequal exchange can be generalized to encompass both of these cases, though much of the simplicity and elegance of our earlier formulation must be sacrificed.

Consider first the case in which there are n commodities all of which are traded and m countries. Let m = n and further assume that each country exports only one commodity. The assumption of complete specialization therefore remains in force. "Countries" in this formulation are not conceptually distinct from "branches" of production. Under these rather restrictive assumptions we may state and prove the following theorem:

Theorem: (Fundamental Theorem of Unequal Exchange) Let the matrix $\hat{A} = (\hat{a}_{ij})$ $(i,j = 1,2,\ldots, n)$ be a matrix of technical coefficients augmented by the direct consumption requirements of workers in each country. Let the matrix $D = (C^k)$ $(k = 1, 2, \ldots, m)$, where each column of D is a vector of consumption coefficients for country k. The augmented A matrix is now: $\hat{A} = A + D\hat{L}$. If as a result of an increase in real wages in country j (and no other) a new vector of relative prices P* is established, it must be true that:

$$p_j^*/p_j > p_i^*/p_i \quad \text{for all } i \neq j.$$

That is, with no trade pattern reversals the terms of trade for the jth country (commodity) will improve relative to all other commodities.

Proof: By the theorems of Perron and Frobenius,[8] we have $r^* < r$ for an increase in any coefficient in the matrix $\hat{A}$ as long as the matrix is indecomposable and nonnegative. To show that p_j^*/p_j has increased the most, choose k so that the price ratio p_k^*/p_k is maximal and suppose $k \neq j$. We then have:

$$p_k^* = (1+r^*)(p_1^*\hat{a}_{1k} + p_2^*\hat{a}_{2k} + \ldots + p_n^*\hat{a}_{nk})$$

which may be written as:

$$p_k^*/p_k = \frac{(1+r^*)}{p_k}\{(p_1^*/p_1)p_1\hat{a}_{1k} + (p_2^*/p_2)p_2\hat{a}_{2k} + \ldots + (p_n^*/p_n)p_n\hat{a}_{nk}\}$$

but since $p_k^*/p_k > p_i^*/p_i$ for all i, we can write:

$$p_k^*/p_k < \frac{(1+r^*)}{p_k}(p_k^*/p_k)\{p_1\hat{a}_{1k} + p_2\hat{a}_{2k} + \ldots + p_n a_{nk}\}$$

or:

$$p_k < (1+r^*)(p_1\hat{a}_{1k} + p_2\hat{a}_{2k} + \ldots + p_n\hat{a}_{nk})$$

which is impossible since r* is less than r. Thus the terms of trade must improve for commodity j relative to all other commodities.

If a given country produces and exports more than one commodity, the conditions of the theory are not met and it cannot be concluded that the terms of trade must move in the same direction as the change in wages. We shall use the following example to see why. Let the center produce and export one commodity while the periphery produces and exports two commodities. The first column of the augmented matrix $\hat{A}$ describes the central process; the last two columns represent the peripheral processes:

$$\hat{A} = \begin{bmatrix} 0.1 & 0.4 & 0.1 \\ 0.5 & 0.5 & 0.01 \\ 0.01 & 0 & 0.2 \end{bmatrix}$$

The profit rate for this example is 26.5% and the vector of prices is:

$$P = (1, 1.377, 0.192).$$

Increasing the wage rate in sectors two and three could, under plausible labor coefficients result in the following matrix:

$$\hat{A} = \begin{bmatrix} 0.1 & 0.4 & 0.1 \\ 0.5 & 0.7 & 0.02 \\ 0.01 & 0 & 0.2 \end{bmatrix}$$

The rate of profit falls to 6.5% with prices:

$$P = (1.0, 1.67, 0.183)$$

Peripheral terms of trade have improved for commodity two but deteriorated for commodity three.

It is easy to appreciate what has happened in our counterexample. Sector two is much more labor intensive than sector three so that an increase in wages affects p_2 more than p_3. Since the center heavily depends upon the second good, the *indirect* effect of the wage increase on p_1 is greater than the direct effect on p_3. Thus, the terms of trade p_3/p_1 deteriorate.

Are any general results available? The fundamental theorem evidently does not rule out the possibility that a simultaneous increase in wages in several peripheral sectors could lead to a deterioration in the terms of trade for some peripheral commodities relative to some central commodities. All we can say in general is that the terms of trade cannot turn against every peripheral commodity since this would imply that the price of some central commodity rose more rapidly than any peripheral good following the wage increase. It is this possibility that the fundamental theorem rules out.

In the simple analytical case of two commodities and two countries, the terms of trade will always improve with an increase in one sector's wage. But with more commodities, the terms of trade can behave perversely and it is even theoretically possible that the total flow of value from periphery to center could increase with an increase in peripheral wages. The practical importance of this theoretical contingency, however, is a matter that can only be settled empirically.

Unequal Exchange with Nonspecific Goods

The next step is to consider trade in nonspecific commodities; that is, we shall now relax the assumption of complete specialization. In order to focus more clearly upon the core of the matter, let us assume that there are only two countries and two commodities, steel and corn. Corn is produced in both the center and periphery, but steel is only produced in the center. There are no transportation costs so that corn in the center is the same commodity as corn in the periphery. We therefore have:

Center

labor + corn + steel ⟶ steel
labor + corn + steel ⟶ corn

Corn is also produced in the periphery by a process of production which is not necessarily the same as that employed in the center.

Periphery

labor + corn + steel ⟶ corn

With the introduction of an additional corn process, this system is mathematically overdetermined; taking wages in both center and periphery as given, there are three equations to determine but two variables, the rate of profit and the corn-steel terms of trade. This overdetermination is at the heart of the critique of unequal exchange offered by de Janvry and Kramer who argue that under conditions of free trade and no transportation costs, lower peripheral wages cannot persist in long-run equilibrium unless counterbalanced by either higher profits or a more costly method of production. Differences in wages that more than offset differences in other costs cannot persist since equilibrium prices are defined as the sum of costs. If wages differences are exactly offset by other costs, no transfer of value occurs. An increase in peripheral wages would not improve the terms of trade but would rather decrease the rate of profit for the peripheral process causing it to contract and eventually disappear. Thus, unequal exchange under conditions of incomplete specialization is apparently a logical impossibility.

From the foregoing, it is obvious that a successful generalization of unequal exchange to the case of non-

specific commodities must first reestablish the equality between the number of processes and the number of endogenous variables. This implies that either the central or peripheral wage rate can be determined endogenously, owing to the existence of the additional peripheral process for corn. But since we are interested in the effect of increasing the level of peripheral wages on the terms of trade, it follows that we should take the peripheral wage rate as given, allowing the central wage to be determined endogenously. Adopting this approach, the price-determining equations for our steel-corn example can now be written:

Center

$$p_1 = (1+r)(p_1 a_{11} + p_2 a_{21} + w\ell_1)$$

$$p_2 = (1+r)(p_1 a_{12} + p_2 a_{22} + w\ell_2)$$

Periphery

$$p_2 = (1+r)(p_1 \hat{a}_{13} + p_2 \hat{a}_{23})$$

where w is the endogenously determined central wage rate. Technical coefficients for the *peripheral* process are written with a circumflex to indicate that they include given labor-feeding coefficients. Note that we could have assumed that the central technical coefficients also include a given level of real wages and define w as a surplus wage which would vary according to the level of wages in the periphery. Either interpretation will suffice.

With an alternative process and the central wage rate determined endogenously, the system of price-determining equations is considerably more complicated. In systems with alternative processes, unfortunately, the Perron-Frobenius theorems for nonnegative matrices — essential to the proof of the theorem above — no longer apply.[9] Even in the case in which the periphery produces and exports only one commodity, it cannot be shown that the terms of trade always move in the same direction as the peripheral wage rate. As an example, consider the following system in which the peripheral wage rises from 0.4 to 0.5 yet the terms of trade deteriorate from unity to 0.84:

Center

$$1 = (1+r)(0.5 + 0.1p_2 + 0.4w)$$

$$p_2 = (1+r)(0.5 + 0.1p_2 + 0.1w)$$

Periphery

$$p_2 = (1+r)(0.2 + p_2 \hat{a}_{23})$$

For which:

$\hat{a}_{23}$	p_2/p_1	w	r
0.4	1.0	0	0.67
0.5	0.84	0.38	0.36

Does this counterexample imply that the theory of unequal exchange in the context of nonspecific goods is a logical impossibility? It is certainly true that the direction of movement of the terms of trade need not *always* be perverse, as a second example shows. Let the price-determining equations take the form:

Center

$$1 = (1+r)(0.5 + 0.1p_2 + 0.1w)$$

$$p_2 = (1+r)(0.5 + 0.1p_2 + 0.4w)$$

Periphery

$$p_2 = (1+r)(0.2 + p_2 \hat{a}_{23})$$

For which:

$\hat{a}_{23}$	p_2/p_1	w	r
0.4	1.0	0	0.67
0.5	1.2	0.46	0.5

Increasing peripheral wages in this case corresponds to a decrease in the transfer of surplus from periphery to center as the terms of trade improve from unity to 1.2.

Note that in both cases the central wage rate rises as the real wage in the periphery goes up. As the coefficient $\hat{a}_{23}$ rises, p_2 rises which means that the residual in process two, captured by central labor, must also increase. But since the same wage must be paid in both process one and two, the price of the first commodity rises as well and hence the possibility that the terms of trade might behave perversely. Of course even if the central and peripheral wage rates move in the same direction, the ratio of central to peripheral wages can increase, decrease or remain constant depending upon the parameters of the system. This implies that the interest of workers in the center are not necessarily opposed to those in the periphery, though there are many plausible instances in which the degree of inequality increases as peripheral wages rise.

While this extension of the theory of unequal exchange to an environment of nonspecific goods is a straightforward application of alternative processes, it is not difficult to see why many commentators have gotten bogged down in their thinking, especially when trying to sort out the problem using the labor theory of value. Amin (1976) for example argued that

unequal exchange with nonspecifics implies that the difference in wages between center and periphery must be greater than the difference in labor productivity. De Janvry and Kramer show that this leads to unequal profit rates contradicting the assumptions of the theory. However, de Janvry and Kramer do not go on to consider differences in the central and peripheral processes *other* than in their *direct* labor requirements. They write: "We ignore differences in the cost of constant capital since this falls under 'nonequivalence in the broad sense' which is not considered here as unequal exchange." (de Janvry and Kramer 1979:8).

In my view, this is clear example of what Ian Steedman had in mind when he recently remarked that the labor theory of value served only as a fetter to the further development of a "materialist account of capitalist society." (Steedman 1977:207). While it is quite true that allowing constant capital to take up the slack makes the decomposition of the price-value differential into its broad and strict sense components more difficult, this is a problem of the labor-value approach to unequal exchange which does not survive the transition to the framework adopted here. Indeed our solution not only allows *direct* constant capital to adjust to take up the slack of lower peripheral wages, but also the *indirect* constant capital to be revalued according to current levels of peripheral wages. And since some of the peripheries' constant capital is imported, central wages become an indirect component of peripheral constant capital. In other words, when the theory of unequal exchange is properly recast in a model of general economic equilibrium, lower wages in the periphery do not necessarily imply higher profits there; the difference may be taken up instead by central worker's wages.

We conclude that the generalization of unequal exchange to the case of incomplete specialization encounters the same difficulty observed in the case of many goods: an increase in peripheral wages can lead to an increase in the quantum of value transferred from the periphery to the center. The possibility that this perversity could arise in empirical studies however does *not* negate the *logical* consistency of the theory of unequal exchange as has been alleged. As in the case of more than two commodities, unequal exchange with nonspecific goods is a thesis whose real-world siginificance must be established by reference to empirical data.

The Dynamics of Unequal Exchange

The introduction of nonspecifics considerably complicates the analysis to the point that it will be helpful to assume complete specialization in the discussion of the dynamics of unequal exchange. Stated in its most condensed form, de Janvry and Kramer's major objection to unequal exchange as a theory of unequal development is that "capital mobility tends to eliminate wage differences." (de Janvry and Kramer: 1979:30). Capital migration from the center to the periphery equalizes the rate of profit, but in so doing also exhausts the reserve army in peripheral countries ultimately causing wages to rise. The initial wage differential is therefore self-cancelling over time and cannot serve as an explanation of growing income inequality.

My principal objection to this scenario is that capital mobility does not *necessarily* imply an uninterrupted flow of capital from center to periphery. The alleged reduction of the wage differential over time cannot therefore be deduced from the theory alone. Some theory of accumulation of capital must ultimately be supplied to explain how the system moves over time. While it is certainly possible to produce a coherent story of how unequal exchange disappears in the long run, the theory as presented here is also entirely consistent with a persistent drain of surplus from periphery to center over time.

To my mind, the essential confusion is between the concepts of "capital mobility" and accumulation of capital through foreign investment. A sufficient condition for the equalization of the rate of profit is the mobility of capital; the long-run self-exhaustion of unequal exchange, on the other hand, requires a continuous flow of investment funds from the center to the periphery. The assumption of capital mobility, however, does not imply that the required investment will be forthcoming. In short, capital can be mobile, yet fail to move; what is required for its actual movement is the incentive of higher *profits*. But the theory of unequal exchange, at least in the form developed here, is an argument made in the classical mode of comparing alternative long-period equilibria under different assumptions about the level of wages. In this steady-state, the vector of relative prices is such that all branches earn the going rate of profit; hence there is no incentive for capital to migrate even though wages are lower and capital is fully mobile.

Thus, it is the *existence* of a set of *reproduction* prices which guarantees that unequal exchange need not be self-cancelling over time. Reproduction prices are defined such that the ratio of the share of surplus accruing to capitalists in any one branch to the value of capital invested in that branch is uniform. At these prices, it is possible for the system to reproduce itself. No necessity is implied; one can only conclude that if nothing in the underlying data changes, the smooth reproduction of the economy is a possibility. The fact that a set of reproduction prices exists even when wages are not uniform from branch to branch means therefore that unequal exchange can persist in the long run.

I suspect that what de Janvry and Kramer really object to is the very method of unequal exchange in which alternative long-period equilibria are compared. They are concerned instead with the traverse between steady-states in which the concept of a reproduction price is not really even applicable. When de Janvry and Kramer ask:

> Since capital is perfectly mobile on a world scale in Emmanuel's model, what is to keep it from moving to those countries where wages are lower in order to take advantage of lower production costs and realize higher profits? (de Janvry and Kramer 1979:28)

it is clear that they have not accepted an initial long-period equilibrium from which to begin their analysis of the effect of a change in wages. If we are comparing steady states, this question never arises since it is assumed that if capitalists had been able to produce their output more cheaply in the periphery, they would have already moved there. Hence, de Janvry and Kramer merely confront a theory of steady states with an argument about what must have happened in the traverse; they have therefore not succeeded in criticizing the theory on its own grounds. Indeed the critique is not so much of unequal exchange as of the assumptions required for the construction of a set of reproduction prices.

Our argument has thus far only been concerned with capital mobility and its role in the equalization of the rate of profit *between* branches of production. We have shown that if reproduction prices hold, then there is no incentive for capital to shift from branch to branch. A separate but related problem is whether low wages provide a sufficient incentive for capitalists within the *same* branch of production to relocate in the periphery. It seems intuitively true that low wages, everything else equal, would induce capital's flight from high-wage countries, resulting in a reduction in wage differentials.

What is worrisome about this argument is the assumption of "everything else equal." The problem of the optimal location of a capitalist firm is not resolved on the basis of one variable, the relative wage in the center and periphery. Since capitalists are interested in low wages only to the extent that they result in higher profits, it follows that they must consider *all* costs, not just wages in deciding where to locate a given enterprise. At a minimum, it would seem that transportation costs as well as the costs of *nontraded* inputs would have to be considered. While it is customary and reasonable to assume away transportation costs and nontraded goods in problems of international trade, it is hardly appropriate to do so when the object of the theory is the profit-maximizing location of the firm. Once these other costs are taken into consideration, it is no longer obvious that capital will migrate automatically in response to a wage differential.

It is important to see that transportation costs can magnify the bias in the terms of trade owing to differences in wages.[10] As an example, let the periphery produce and export rubber while importing plows produced in the center. Both center and periphery use domestically produced steel in the production of their commodities, but steel is not traded on the world market. Schematically we have:

Center

labor + central steel + rubber ⟶ plows

labor + central steel ⟶ central steel

Periphery

labor + plows + peripheral steel ⟶ rubber

labor + peripheral steel ⟶ peripheral steel

If transportation costs for steel are greater than the wage differential between central and peripheral labor, the central steel process will not relocate in the periphery. Peripheral steel will continue to be produced and used to supply peripheral rubber exporters. If transportation costs are significant, the wage differential in *steel production* can substantially bias the rubber-plow terms of trade The bias can of course operate in both directions; even given the wage differential, peripheral costs can be higher owing to the direct and indirect costs of steel production.

What is interesting about the case of nontraded goods in an environment in which transportation costs are taken into account is the effect on the decision of central capitalists to relocate in the periphery. If at a given level of wages and profits, peripheral nontraded processes operate at higher domestic costs, the incentive to relocate can be significantly dampened. At a different level of wages, the pattern of trade may of course change as central capitalists move to low-wage countries. But as observed above in the discussion of trade-pattern reversals in the simple 2-good case, the net effect on the terms of trade and the rate of profit turns on the technology and interindustry relations.

All of the foregoing is not to deny the possibility that runaway shops *can* cause wages to rise in poor countries and that unequal exchange *could* disappear in the long run. What we are saying is that the analysis of the phenomenon is extraordinarily complex and cannot be accomplished by way of simple ceteris paribus assumptions. Unfortunately, nothing short of a complete, dynamical theory of the laws of motion of the capitalist mode of production is required, the crux

of which must be some theory of the time-path of investment. It may be argued that unequal exchange implicitly assumes steady, balanced expansion as its dynamic counterpart and if so I would be the first to agree that it is hopelessly inadequate if we have a capitalist society in mind. On the other hand it is even less satisfactory to suggest that a theory of the time path of investment can be extruded from the assumption of capital mobility and the process of the equalization of the rate of profit. To my mind, it is not only incorrect but also highly counterproductive to burden the theory of unequal exchange with a defective dynamical analysis and then after having grown dissatisfied with the latter, to reject the former as well.

Recently Steedman, Metcalfe and Mainwaring together with their neoclassical adversaries Samuelson, Smith and Burmeister have devoted considerable attention to the comparative dynamics of trading economies.[11] A number of results have been obtained, the most interesting of which is the possibility of negative gains from trade owning to a divergence between the steady-state rate of growth and the equalized profit rate. Perverse patterns of trade specialization may occur with the result that per capita consumption is lower with trade than in autarky. But it is to be emphasized that these results were only obtained under the very restrictive conditions of either expanded reproduction at a uniform and constant rate, or a very well-defined transition between autarky and a steady-state. The realism of these models can hardly be defended; but on the other hand, their very complexity serves as a warning to those inclined to draw quick conclusions from more casual analysis.

The Empirical Relevance of Unequal Exchange

Finally, we turn to the allegation that unequal exchange is empirically insignificant. In this section a 67-sector model of world trade is presented in an attempt to demonstrate that the flow of value from periphery to center is hardly negligible in magnitude.

As one might expect, even at the 67-sector level, world trade is not completely specialized. But rather than introduce a complete set of alternative processes, for peripheral sectors, a more approximate method was adopted for the empirical estimates. Each sector was represented by an output-weighted average of central and peripheral technologies. In this approach, equalizing the wage rate increases the effective wage rate for sectors in which more than 50% of world output is produced in the periphery and vice-versa for sectors for which less than 50% of output is produced in the periphery. Equal wage prices are computed and then used to value exports and imports of any given social formation in order to measure the flow of value.[12]

A representative bundle of imports and exports traded between Peru and the United States in 1969 was used and sectors were defined in a way such that the majority of the world's output was located in a particular region, either the center or periphery.[13] Sectors and output weights are listed in Table 1. Four input-output matrices were then combined using these weights; periphery technologies were taken from the Peru's input-output matrix for 1969[14] and central technologies were taken from the U.S. matrix for 1967.[15] Mining technologies were lifted from a matrix compiled by the U.S. Bureau of Mines and the peripheral mining technologies were taken from the input-output matrix for Chile in 1963.[16]

Prior to aggregating the central and peripheral matrices according to output weights, two adjustments had to be made. First, imports of intermediate goods had to be added to each of the matrices, since imports were no longer distinguished from interindustry transactions. A world trade matrix was estimated and then divided into a matrix for central and peripheral imports. The latter matrices were then added to the original central and peripheral matrices to endogenize central imports from other central countries and peripheral imports from other peripheral countries. This modification was slight for the center but considerable in the case of the periphery. A second change was to adjust the coefficients to reflect capital consumed. Input-output matrices only report intermediate flows and do not consider the amount of fixed capital consumed in the course of a period of production. This required an estimation of a capital stock matrix and turnover times for each sector for both the center and periphery. The procedure for the estimation of the capital stock matrix is described in a footnote.[17] Once the capital stock matrix was in hand, a replacement matrix was calculated using depreciation quotas from IRS Bulletin F and added back into the central matrix to obtain a matrix of constant capital. The same was done for the periphery, although the capital stock estimates are of course much less reliable.

Labor coefficients were taken as a weighted average of U.S. and Peruvian data. Consumption coefficients were estimated from a Peruvian budget study for the periphery and from the U.S. matrix for the center.[18]

It is now possible to calculate the flow of value implicit in trade of our representative bundle. This import-export basket is shown in Table II. Since Peru exports more to the United States than it imports — even at current prices — exports were scaled to agree with total imports.

In order to estimate the flow of value implicit in this exchange, we first combine the consumption vectors of both the periphery and center in order to arrive at an average "real" wage. This real wage is used to compute equal-wage prices as the left hand eigenvector

associated with the maximal eigenvalue of the matrix $K(I-A).^{-1}$ These prices may be written:

$$P = PA + rPK$$
$$P = rPK(I-A)^{-1}$$

where A is the matrix of international transactions including imports, labor and capital consumed in one year; r is the equalized competitive rate of profit and K is a matrix of capital coefficients where:

$$a_{ij}t_{ij} = k_{ij} \qquad (i,j = 1,2, \ldots, n)$$

and t_{ij} is the turnover time for commodity i used in the jth process.

Since the input-output matrices are compiled in price terms, the prices which result from this calculation are prices per dollar of output (where output is measured of course at market prices.) Hence, the data of Table III is essentially the ratio of equal-wage prices to market prices for a composite commodity made up of the individual commodities within each sector. The absolute magnitude of the flow of value due to unequal exchange depends upon the level of the numeraire. In this study, the endogenously determined level of money wages was set equal to one. This implies that at competitive prices of production, workers would just be able to purchase the commodities actually consumed at existing prices. Since real consumption is assumed to remain unchanged (central and peripheral workers share equally in the same total consumption vector) money wages is an appropriate choice of numeraire. Any other choice of numeraire would not allow the sum of existing money wages to be properly reflected in the flow of value due to unequal exchange.[19] The wage numeraire insures that the total distortion due to unequal wages is captured which is of course the object of the study.

Note that the absolute value of this ratio for the agricultural sectors dominated by the periphery (cotton and coffee) are not among the highest. This is because competitive prices of production distribute surplus in proportion to the value of capital invested and the capital invested in these peripheral agricultural sectors is notoriously low.[20] The result is that competitive prices, even when wages are equalized, are low. The rate of profit for this exercise was a hearty 27.5% indicating that the world economy was considerably below its growth potential.

The next step is to apply these equal-wage prices to the import-export bundle to estimate the flow of value. The results of this calculation are shown in Table IV. There it is seen that the total value of imports is approximately 249.5 million U.S. dollars while exports are revalued at 343.6 million. From the point of view of the periphery, this constitutes an overcharge of some $94 million on an exchange of 249.5 million, or in other words some 37.7% of exports were transferred due to unequal exchange in the strict sense. This percentage represents a loss in real resources inasmuch as it indicates that if prices were determined according to equal wages, the periphery could import 37.7% more of each commodity without increasing its exports.

Can this figure be generalized to trade between the center and the periphery as a whole? The first question that must be asked is how typical of the periphery is Peru? In 1969, Peru ranked 24th out of 29 Latin American countries in terms of income per capita. The average for the "developing market economies" as a whole in 1969 was $200; Peruvian income per capital for the same year was $273 which places it somewhat above the peripheral countries as a whole but in the lower reaches of the distribution for Latin America. Table V shows comparative wages in manufacturing and agriculture for many countries in the capitalist world. Again Peru is lower than the Latin American average but more than what is paid on average in Africa and Asia.

Peru was selected as the representative country for the periphery primarily because it is very specialized in resource-intensive exports. The country produces a wide variety of primary products from the agricultural, fishing and mining sectors and exports a variety of products from each of these branches. In agriculture, its principal export products are cotton, wool, coffee and sugar; in minerals lead, copper, iron and zinc; and in fishing Peru exported 14.7 percent of the world's production of anchovies in 1969. Only 3 percent of Peru's exports could be considered manufactured articles, and most of these are primary metals. Hence, even by periphery standards, Peru's exports are relatively resource intensive inasmuch as the average percentage manufactured goods in total exports of the periphery to central countries was 23 percent in 1969. Since unequal exchange is conceived here as a study of surplus transfer in trade owing to an international division of labor, Peru was particularly well-suited as a provider of peripheral technologies. Ideally, we would have drawn upon other peripheral countries for manufacturing technologies in order to average in with the center's coefficients. The net effect, however, would have been to increase the flow of value from periphery to center so that the figures presented, at least in this regard, are understated.

At *current* prices, a savings of 37.7% of exports amounts to approximately $70 million for Peru. Total exports from peripheral to central countries are given in Table VI, in which it can be seen that on a world scale, the magnitude involved is on the order of a quarter of peripheral of imports. Obviously these figures are much lower than Emmanuel's suggestion that the order of magnitude was $2-300 billion. (Emmanuel 1972:368) But it would nevertheless be difficult to as-

sert that one-quarter of current imports is a negligible figure for the annual transfer of value. Amin (1976:144) is more reserved in his estimate of unequal exchange, even though no more rigorous, placing the figure at some 22 billion. "One is certainly justified," Amin concludes on the basis of this magnitude, "in talking of the plundering of the Third World."

Table VI shows that indeed the quantities involved are by no means insignificant in comparison with the levels of foreign aid and direct foreign investment in peripheral countries. It is by now hardly necessary to point out that the figure describing the transfer of value is a *flow* per annum whose cumulative effects on the relative stocks in center and periphery can be vastly more significant than one might guess from the flows alone.

There is little doubt that the estimates of the flow of value from periphery to center could be improved in relation to what has been presented here. More accurate specification of the technologies, of disaggregation, all of these refinements would doubtlessly improve the estimates. The next step would then be to construct a model such that nonspecifics and nontraded goods were explicitly taken into account via alternative processes — rather than hidden in the averaging technique used here. The computational problems with this approach are formidable however since the system of equations would not be solvable by the normal computational methods employed here.

Summary and Conclusions

De Janvry and Kramer offer three criticism of the theory of unequal exchange all of which are judged off the mark in light of evidence produced in this essay. Though the theory of unequal exchange — not unlike most trade theory — was initially presented under the restrictive assumption of complete specialization it can be generalized to a world in which there are nontraded and nonspecific commodities. Complete specialization is an assumption of great simplifying powers; about this there can be no doubt. It is therefore not surprising to learn that these modifications are costly in terms of the elegance and simplicity of Emmanuel's original thesis. But a critique whose main objective is to confront a coherent proposition based on explicit assumptions with evidence gathered to show that one or more of these assumptions is false is simply incomplete and in itself constitutes no critique whatsoever. It is rather necessary to show that the assumption in question is "essential" in the specific sense that if relaxed the main result cannot be obtained. This the critics fail to do as the numerical counterexample of page 22 clearly demonstrates. The first charge of the "logical inconsistency" of unequal exchange is therefore without foundation.

The second criticism, that unequal exchange tends to be self-cancelling over time is seen to be the result of an inadequate formulation of the dynamics of unequal exchange. As originally set forth, unequal exchange involved a steady-state comparison of terms of trade under different assumptions about the level of wages in center and periphery. Given the size and composition of output, the technology, and the level and distribution of wages, a set of reproduction prices are computed according to the rule that the share of surplus should be proportional to the value of capital invested. Such prices guarantee that capitalist economy can reproduce itself over time, if no other changes intervene. The critics properly ask how the theory performs when the assumption of the steady state is relaxed, but in grafting on an oversimplified account of the dynamics or the transition between steady states, become disillusioned. In my view, the evolution of the material conditions of production and the spatial location of capitalist enterprises is simply not a problem which can be adequately handled in the framework of a formal model which assumes no transportation costs, no nontraded commodities and no choice of technique.

Finally, our authors assert that unequal exchange, due to the existence of nonspecific commodities, is an empirically irrelevant phenomenon. To the extent that this conclusion derives from their first criticism, it is false; there is no critique of unequal exchange based on its alleged inability to deal with nonspecifics. As a general proposition, the criticism is also without foundation as the results of the empirical study discussed above confirm. The order of magnitude of the transfer of value is far less than suspected by Emmanuel and is closer to Amin's own estimate for the representative case considered. The flow is nevertheless substantial in that it exceeds both the amount of foreign aid and direct private investment in peripheral countries.

Whether unequal exchange constitutes a "basis for a general theory of underdevelopment" or as Emmanuel has argued "the *elementary* transfer mechanism" remains a matter of judgement. But one point should nevertheless be clear: as a static theory of surplus transfer in trade, unequal exchange cannot possibly account for the way in which the surplus is used once appropriated. It may be consumed by capitalists or workers; it may be accumulated as capital or re-exported as foreign investment. The actual outcome depends upon the nature and intensity of class struggle, the political conjuncture, indeed upon the myriad of variables which make up what is now fashionable referred to as the "overdetermined social totality." To measure its performance against this criteria is to submit to a theoretical utopianism at worst and at best to fail to give the theory of unequal exchange a fair and proper hearing.

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TABLE I:

CENTRAL OUTPUT WEIGHTS USED IN THE CONSTRUCTION OF THE INTERNATIONAL MATRIX

Sector		*Sector*	
1. Livestock products	.717[a]	35. Glass, stone, and clay	.938[a]
2. Livestock	.717[a]	36. Primary iron and steel	.930[a]
3. Cotton	.264[b]	37. Primary copper	.736[b]
4. Coffee	.009[b]	38. Primary lead	.851[b]
5. Grains	.524[a]	39. Primary zinc	.911[b]
6. Other agriculture	.509[a]	40. Primary aluminum	.948[b]
7. Forestry and fishing	.472[a]	41. Primary nonferrous	.966[b]
8. Iron ore mining	.614[a]	42. Metal products	.940[a]
9. Lead and zinc mining	.729[a]	43. Engines and turbines	1.000
10. Copper mining	.547[a]	44. Farm machinery	1.000
11. Bauxite mining	.384[a]	45. Construction and mining equipment	1.000
12. Manganese mining	.138[a]	46. Material handling machinery	1.000
13. Coal mining	.908[a]	47. Metalworking machinery	1.000
14. Other mining	.839[a]	48. General machinery	1.000
15. Crude petroleum	.312[a]	49. Office machinery	1.000
16. Natural gas	.911[a]	50. Service industry machinery	1.000
17. Food processing	.945[a]	51. Industrial electrical equipment	1.000
18. Fishmeal	.285[b]	52. Household appliances	1.000
19. Sugar	.895[b]	53. Electrical lighting	1.000
20. Tobacco	.714[b]	54. Other electrical equipment	1.000
21. Textiles	.785[a]	55. Motor vehicles and equipment	.995[a]
22. Footwear	.905[a]	56. Aircraft and parts	1.000
23. Apparel	.785[a]	57. Other transportation equipment	.922[a]
24. Lumber and wood products	.906[a]	58. Miscellaneous manufacturing	.897[a]
25. Veneer and plywood	.464[c]	59. Construction	.904[a]
26. Furniture	.856[a]	60. Transportation	.884[a]
27. Paper	.959[a]	61. Communications	.915[a]
28. Printing and publishing	.963[a]	62. Utilities	.942[a]
29. Leather	.714[a]	63. Wholesale and retail trade	.922[a]
30. Rubber	.966[a]	64. Finance and real estate	.922[a]
31. Industrial chemicals	.903[a]	65. Services	.906[a]
32. Fertilizers	.831[a]	66. Ordnance	1.000
33. Other chemical	.929[a]	67. Government	.906[a]
34. Petroleum refining	.904[a]		

SOURCES: a. Leontief (1977); b. U.N. (1971); c. U.N. (1971a)

TABLE II:

PERU-U.S. TRADE (THOUSANDS OF DOLLARS)
Exports are scaled to imports

	Imports	*Exports*		*Imports*	*Exports*
1. Livestock products	955.	20.	35. Glass, stone and clay	2869.	166.
2. Livestock	345.	124.	36. Primary iron and steel	5099.	0.
3. Cotton	0.	935.	37. Primary copper	26.	5910.
4. Coffee	0.	12570.	38. Primary lead	11.	9166.
5. Grains	8075.	136.	39. Primary zinc	39.	0.
6. Other agriculture	1430.	993.	40. Primary aluminum	1314.	0.
7. Forestry and fishing	0.	706.	41. Primary non-ferrous	132.	2654.
8. Iron ore mining	0.	5446.	42. Metal products	11572.	0.
9. Lead and zinc ore mining	0.	16733.	43. Engines and turbines	9878.	0.
10. Copper ore mining	0.	81708.	44. Farm machinery	900.	0.
11. Bauxite ore mining	0.	0.	45. Construction and mining equip.	7250.	0.
12. Manganese ore mining	0.	0.	46. Material handling mach.	2555.	0.
13. Coal mining	0.	0.	47. Metalworking mach.	216.	0.
14. Other mining	785.	2330.	48. General machinery	25127.	0.
15. Crude petroleum	480.	311.	49. Office machinery	970.	0.
16. Natural gas	0.	0.	50. Service industry mach.	527.	0.
17. Food processing	4298.	397.	51. Industrial electrical equip.	1246.	0.
18. Fishmeal	0.	16475.	52. Household appliances	1394.	0.
19. Sugar	0.	24450.	53. Electrical lighting	580.	0.
20. Tobacco	1653.	0.	54. Other electrical equip.	12418.	0.
21. Textiles	3599.	2180.	55. Motor vehicles and equip.	20963.	0.
22. Footwear	42.	2.	56. Aircraft and parts	1785.	0.
23. Apparel	176.	0.	57. Other transportation equip.	1377.	0.
24. Lumber and wood products	1722.	111.	58. Miscellaneous manufacturing	7957.	447.
25. Veneer and plywood	0.	362.	59. Construction	0.	0.
26. Furniture	0.	0.	60. Transportation	0.	0.
27. Paper	4837.	0.	61. Communications	0.	0.
28. Printing and publishing	2159.	10.	62. Utilities	0.	0.
29. Leather	128.	462.	63. Wholesale and retail trade	0.	0.
30. Rubber	3398.	687.	64. Finance and real estate	0.	0.
31. Industrial chemicals	14910.	137.	65. Services	0.	0.
32. Fertilizers	2146.	0.	66. Ordnance	105.	0.
33. Other chemical	13228.	84.	67. Government	0.	0.
34. Petroleum refining	5028.	0.	*TOTAL*	185725.	185725.

TABLE III:

EQUAL-WAGE PRICES ASSOCIATED WITH A RATE OF PROFIT OF 27.5%

1. Livestock products	1.32	35. Glass, stone and clay	1.45
2. Livestock	1.41	36. Primary iron and steel	1.74
3. Cotton	1.27	37. Primary copper	1.87
4. Coffee	1.62	38. Primary lead	1.79
5. Grains	1.31	39. Primary zinc	1.87
6. Other agriculture	1.26	40. Primary aluminum	1.40
7. Forestry and fishing	1.20	41. Primary non-ferrous	1.48
8. Iron ore mining	1.81	42. Metal products	1.34
9. Lead and zinc ore mining	1.80	43. Engines and turbines	1.33
10. Copper ore mining	1.98	44. Farm machinery	1.34
11. Bauxite ore mining	2.35	45. Construction and mining equip.	1.30
12. Manganese ore mining	2.90	46. Material handling mach.	1.28
13. Coal mining	1.82	47. Metalworking machinery	1.25
14. Other mining	1.98	48. General machinery	1.23
15. Crude petroleum	1.75	49. Office machinery	1.22
16. Natural gas	.61	50. Service industry mach.	1.30
17. Food processing	1.47	51. Industrial electrical equip.	1.26
18. Fishmeal	2.56	52. Household appliances	1.35
19. Sugar	1.27	53. Electrical lighting	1.20
20. Tobacco	.83	54. Other electrical	1.20
21. Textiles	1.36	55. Motor vehicles and equip.	1.38
22. Footwear	1.66	56. Aircraft and parts	1.36
23. Apparel	1.34	57. Other transport equip.	1.40
24. Lumber and wood products	1.37	58. Misc. manufacturing	1.31
25. Veneer and plywood	1.84	59. Construction	1.29
26. Furniture	1.31	60. Transportation	2.02
27. Paper	1.35	61. Communications	1.16
28. Printing and publishing	1.36	62. Utilities	2.04
29. Leather	1.36	63. Trade	1.09
30. Rubber	1.23	64. Finance and real estate	.80
31. Industrial chemicals	1.36	65. Services	1.24
32. Fertilizers	1.57	66. Ordnance	1.27
33. Other chemical	1.30	67. Government	2.68
34. Petroleum refining	1.65		

TABLE IV:

PERU-U.S. TRADE WITH EQUAL WAGES
Thousands of U.S. dollars

	Imports	*Exports*		*Imports*	*Exports*
1. Livestock products	12698.	26.	35. Glass, stone and clay	4180.	242.
2. Livestock	488.	176.	36. Primary iron and steel	8915.	0.
3. Cotton	0.	1189.	37. Primary copper	49.	11105.
4. Coffee	0.	20402.	38. Primary lead	21.	16429.
5. Grains	10630.	179.	39. Primary zinc	74.	0.
6. Other agriculture	1807.	1255.	40. Primary aluminum	1850.	0.
7. Forestry and fishing	0.	850.	41. Primary non-ferrous	196.	3950.
8. Iron ore mining	0.	9894.	42. Metal products	15580.	0.
9. Lead and zinc ore mining	0.	30231.	43. Engines and turbines	13197.	0.
10. Copper ore mining	0.	162298.	44. Farm machinery	1213.	0.
11. Bauxite ore mining	0.	0.	45. Construction and mining equip.	9429.	0.
12. Manganese ore mining	0.	0.	46. Material handling mach.	3282.	0.
13. Coal mining	0.	0.	47. Metalworking machinery	270.	0.
14. Other mining	1555.	4614.	48. General machinery	31092.	0.
15. Crude petroleum	842.	545.	49. Office machinery	1190.	0.
16. Natural gas	0.	0.	50. Service industry mach.	690.	0.
17. Food processing	6346.	587.	51. Industrial electrical equip.	1573.	0.
18. Fishmeal	0.	42252.	52. Household appliances	1892.	0.
19. Sugar	0.	31228.	53. Electrical lighting	698.	0.
20. Tobacco	1387.	0.	54. Other electrical equip.	14959.	0.
21. Textiles	4913.	2975.	55. Motor vehicles and equip.	28988.	0.
22. Footwear	71.	3.	56. Aircraft and parts	2439.	0.
23. Apparel	237.	0.	57. Other transportation equip.	1940.	0.
24. Lumber and wood products	2367.	153.	58. Miscellaneous manufacturing	10482.	589.
25. Veneer and plywood	0.	669.	59. Construction	0.	0.
26. Furniture	0.	0.	60. Transportation	0.	0.
27. Paper	6536.	0.	61. Communications	0.	0.
28. Printing and publishing	2943.	14.	62. Utilities	0.	0.
29. Leather	174.	631.	63. Wholesale and retail trade	0.	0.
30. Rubber	4194.	848.	64. Finance and real estate	0.	0.
31. Industrial chemicals	20423.	187.	65. Services	0.	0.
32. Fertilizers	3378.	0.	66. Ordnance	134.	0.
33. Other chemical	17237.	110.	67. Government	0.	0.
34. Petroleum refining	8321.	0.	*TOTAL*	249471.	343644.

TABLE V:

COMPARATIVE WAGES
(Thousands of U.S. dollars)

Region	*Wages in manufacturing 1969*	*Wages in agriculture 1969*
	dollars per day	
Africa		
Algeria	3.82	—
Egypt	1.85	—
Ghana	3.18	1.46
Kenya	4.01	0.86
Malawi	1.66	0.49
Mauritius	1.07	1.03
Sierra Leone	1.13	—
Republic of South Africa	7.49	—
Zambia	4.34	2.10
America		
Argentina	3.19	2.08
Brazil	4.62	—
Canada	20.75	—
Colombia	2.57	0.97
Chile	4.20	—
Ecuador	2.49	—
El Salvador	2.67	—
Guatemala	3.46	—
Mexico	6.48	—
Peru	2.91	0.92
Puerto Rico	13.23	—
United States	25.52	—
Venezuela	9.89	—
Asia and the Middle East		
Cyprus	3.59	3.10
India	1.44	—
Israel	6.69	5.06
Japan	8.61	3.42
Pakistan	1.62	0.52
Sri Lanka	1.29	0.51
Syria	2.52	—
Thailand	1.43	—
Europe		
Belgium	9.50	5.78
Denmark	14.97	7.05
Federal Republic of Germany	10.76	—
Greece	4.02	—
Italy	6.24	—
Netherlands	9.34	8.30
Portugal	—	1.64
Oceania		
Australia	12.72	

SOURCE: ILO (1976: Tables 1, 19A, 23, 24, 27A).

TABLE VI:

SURPLUS TRANSFER IN TRADE BETWEEN CENTER AND PERIPHERY

year	*imports* $\times 10^{-9}$ *\$US*	*equal wage value*	$\neq \times \mid \Delta$ *savings*	*private*[a] *investment*	*official*[a] *flows*
1967	30.33	22.0	8.3	4.38	7.05
1968	33.75	24.5	9.2	6.46	7.04
1969	37.02	26.9	10.1	6.54	7.19
1970	41.91	30.4	11.5	7.75	7.96
1971	47.14	34.2	12.9	8.20	9.03

SOURCE: Author's computations and U.N. (1978: 56-7); a. Zuvekas (1979: 343).

NOTES

1. De Janvry and Kramer (1979).

2. The point of this section is not a general attack on the labor theory of value but rather to question its usefulness in the particular application of international trade. As most readers are probably aware, a copious literature, bristling with controversy, now exists on the issue of the relevance of the labor theory of value to Marxian analysis in general. My own view is that the labor theory of value was a valid and historically appropriate medium in which Marx fashioned his theory of capital and profits. As Steedman (1977) amply demonstrates, the labor theory of value is not logically essential to Marx's argument about the origin of profits and his theory of capital. It can be replaced with a fully disaggregated system of physical quantities which may then be manipulated by the machinery of linear algebra to obtain the same results. The principal advantage of Marx's approach was its simplicity; its disadvantage lay in its imprecision. Thus in regard to capital theory, it is largely a matter of taste as to which method of exposition is adopted. But in either event, the result is the same: the existence of a positive rate of profit implies that commodities will not generally exchange in proportion to the amount of labor embodied in them. Thus, if Marx's theory of *capital* is accepted, the labor theory of value is irrelevant to the analysis of capitalist economies, for which the rate of profit is positive, engaged in international trade.

3. Emmanuel (1972: Chapter 2 and 160-164).

4. *Ibid.*

5. The points in this paragraph can be seen as follows: let c_i, v_i and s_i be the constant capital, variable capital and surplus-value of the ith sector respectively, all measured in hours of socially necessary labor time. *Marxian* prices (as distinguished from prices of production) are then defined as:

$$p_i = (1+r)(c_i + v_i) \quad (i = 1, 2, \ldots, n)$$

where r is the average rate of profit:

$$r = \frac{\sum s_i}{\sum c_i + v_i}$$

which can be written:

$$r = \frac{\hat{e}}{\hat{\theta} + 1}$$

Here $\hat{e}$ and $\hat{\theta}$ are the economy-wide rate of surplus-value and organic composition of capital respectively. Marxian prices are distinguished from prices of production by the fact that constant and variable capital are measured in value as opposed to price terms and the rate of profit is determined by a separate equation. See Morishima (1973) especially chapter six. Values are then defined as:

$$\lambda_i = c_i + v_i + s_i = \frac{(\theta + 1 + e_i)}{v_i}$$

The ratio of prices to values for the ith sector is then:

$$p_i/\lambda_i = \frac{\theta + 1 + \hat{e}\left(\frac{\theta_i + 1}{\hat{\theta} + 1}\right)}{\theta_i + 1 + e_i}$$

If the rate of surplus-value is uniform, sectors with higher organic compositions than average sell at prices greater than their values. If the rate of surplus-value varies from sector to sector however, prices are equal to values if:

$$e\left(\frac{\theta_i + 1}{\hat{\theta} + 1}\right) = e_i$$

Hence, if the organic composition is below average, prices can still equal values if the rate of surplus-value is also below average.

6. The slope, curvature and limit as $p \to \infty$ of the curves of figure two are determined as follows: Let:

$$c_i = (pa_{1i} + a_{2i}) \qquad i = 1, 2 \qquad p = p_1/p_2$$

so that:

$$r_1 = \frac{p - c_1}{c_1}$$

we have:

$$dr_1/dp = \frac{a_{21}}{c_1^2} > 0 \quad (*)$$

$$dr_2/dp = \frac{-a_{12}}{c_2^2} > 0 \quad (**)$$

The curves approach asymptotes given by:

$$\lim_{p \to \infty} r_1 = \frac{1 - a_{11}}{a_{11}} \qquad \lim_{p \to \infty} r_2 = -1$$

The curvature is easily established from (*) and (**):

$$d^2r_1/dp^2 = \frac{-2a_{11}a_{21}}{c_1^3} < 0$$

$$d^2r_2/dp^2 = \frac{2a_{12}^2}{c_2^3} > 0$$

7. That higher real wages always correspond to a lower profit rate can be shown by way of a corollary of the Perron-Frobenius theorem which holds that the dominant root of the characteristic equation of any nonnegative, indecomposable matrix is an increasing function of its elements. See Pasinetti (1977: 272).

8. Pasinetti (1977: appendix).

9. Joint production and/or alternative processes require that an output matrix $\mathbf{B} = (b_{ij})(i,j = 1,2,\ldots,n)$ be defined where b_{ij} is the output of the ith good by the jth process. The price system is then written:

$$PB = (1+r)P\hat{A}$$

$$P = (1+r)P\hat{A}B^{-1}$$

But while $\hat{A}$ and B are necessarily nonnegative, $\hat{A}B^{-1}$ is not; hence the Perron-Frobenius theorems for nonnegative matrices do not necessarily apply.

10. The introduction of nontraded goods does not change the analysis developed here in any fundamental way. As long as each pole only exports one good, it can still be shown that the terms of trade move in the same direction as peripheral wages. Let there be m countries and n commodities. Let $n < m$ and assume that no commodity is produced by two countries. The kth country produces n_k goods of which t_k are traded and $n_k - t_k$ are nontraded. Let the subscript t refer to traded goods and n refer to nontraded goods; we can write for the kth country in world trade equilibrium:

$$(p_t p_n)^k = (1+r)(p_t p_n)\begin{bmatrix} A_{tt} & A_{tn} \\ A_{nt} & A_{nn} \end{bmatrix}$$

where A_{tt} is dimension $t \times t_k$ and A_{tn} is $t_k \times (n_k - t_k)$ etc. p_t^k can therefore be written:

$$p_t^k = (1+r)\, p_t^k \{A_{tt} + (1+r) A_{tn} [I - (1+r)A_{nn}]^{-1}\}$$

$$p_t^k = (1+r)p_t^k M(r)$$

where $M(r) = A_{tt} + (1+r) A_{tn} [I - (1+r) A_{nn}]^{-1}$ by the Perron-Frobenius theorem is an increasing function of r. Consider an increase in wages in country i; the terms of trade for all commodities exported by country i cannot deteriorate with respect to any given commodity in the world economy.

Proof: Assume there exists a commodity j produced in country k for which all of the ith countries' terms of trade deteriorate following an increase in wages in country i. For the kth country we have: (superscript k has been suppressed for notational simplicity)

$$p_t^* = (1+r)p_t^* M(r^*)$$

$$p_t^* = (1+r)p^* \hat{p}^{-1} \hat{p} M(r^*)$$

where the circumflex indicates a square matrix with p's on the diagonal. But since p^*/p_j has by assumption increased more rapidly than any other price in the world economy, we may write: (with subscript t suppressed)

$$p^* < (1+r^*)\, p_j^*/p_j \mathbf{1} \hat{p} M(r^*) = (1+r)p_j^*/p_j p M(r^*)$$

where $\mathbf{1}$ is a row vector of ones. Consider the jth element of p^*:

$$p_j^* < (1+r^*)p_j^*/p_j p M(r^*)^j$$

$$p_j < (1+r^*)p M(r^*)^j$$

where the superscript on the matrix $M(r^*)$ indicates the jth column of $M(r^*)$. But this is impossible since $r > r^*$.

11. Most of Metcalfe, Steedman and Mainwaring's important work has recently been collected in Steedman (1979). Also see Samuelson (1973; 1975; 1978a; 1978b); Smith (1978). Also see Burmeister (1978) and Mainwaring (1978).

12. Note that the problem of specifics vs. nonspecifics is partially a product of an outlook wedded to the nation-state as the primary unit of analysis. Indeed, nothing prevents our abandoning the grid of the nation-states, beginning instead with the commodity. The fact that the commodity is produced in various political entities is then irrelevant to the determination of relative prices: the conditions of production including the wage are defined as the average (weighted by outputs) of the several processes by which the commodity is produced. Note that even within one nation-state, regional differences require an average of productive conditions to represent any given industry. The approach of this section then is to simply extend this concept to the world capitalist system as a whole.

13. Statistically, the "periphery" means all capitalist countries in the Western Hemisphere with the exception of the United States and Canada; Africa with the exception of South Africa; Asia with the exception of Japan; and the Middle East with the exception of Israel. The socialist countries of Africa were included within the periphery, while the socialist countries of Asia were not. The "center" includes the remaining capitalist countries of Europe and Oceania; Yugoslavia was also considered part of the center. There are no intended political statements implicit in this choice; it is purely utilitarian (i.e. it conforms to the largest number of sources used).

14. Instituto Nacional de Planificacion (1973).

15. U.S. Department of Commerce (1974).

16. Oficina de Planificacion Nacional (1962).

17. The estimate of replacement capital was based upon the 1967 capital flow matrix published in U.S. Department of Commerce (1975) and a capital stock study done by B. Vaccara for the BEA in 1975 in which estimates of discards were made according to the 1967 input-output sector definitions. The capital flow matrix was first scaled to include scrap and second-hand goods in order to follow the treatment of the basic flow matrix. Next, all entries were increased proportionately by the amount of imported capital equipment so that the matrix was converted from a U.S. to a central matrix from the beginning. In cases where the level of detail was insufficient, for example in mining, fishing and plywood, columns and rows were split in proportion to total intermediate inputs from that sector. This procedure considerably reduces the rank of the capital matrix, but its singularity is never of any consequence. In order to convert the matrix into a replacement capital flow matrix, the ratio of replacement investment (discards) to total investment was calculated using the results of the above cited capital stock study. These discards were inflated to 1967 dollars and divided by the capital flow matrix column totals and used to reduce the flow matrix. The central assumption in this procedure is that gross capital formation in any given industry a fixed proportion is used as replacement irrespective of the kind of capital equipment or structure. It would have been preferable to have estimates of replacement of capital stock by commodity, but the BEA has not developed these estimates.

Adjustments were made to both the domestic flow matrix and the imported flow matrix of Peru to reflect the depreciated fixed capital component of constant capital for the periphery. Total capital consumption bridged to the Peruvian matrix was estimated by the INP; but there is, of course, no existing estimate of capital flows for Peru. The 1963 Economic Census tabulates domestic and imported fixed assets for manufacturing divided into five categories: vehicles, office equipment, buildings, and industrial machinery. From these two basic data sources, an estimate — albeit crude — was pieced together.

18. Instituto Nacional de Planificacion (1975).

19. It is true that the notion of a *total* flow of value due to unequal exchange is in many respects arbitrary. Not only is the choice of numeraire an important determinant of the total quantity of surplus transfer, but also the level at which wages are equalized.

20. This is primarily because prices of production fail to take into consideration rents.

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