

THE POLITICS AND MORALITY OF UNEQUAL EXCHANGE

Emmanuel and Roemer, Analysis and Synthesis

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When the relative importance of the national exploitation from which a working class suffers through belonging to the proletariat diminishes continually as compared with that from which it benefits through belonging to a privileged nation, a moment comes when the aim of increasing the national income in absolute terms prevails over that of the relative share of one part of the nation over the other. From that point onward the principle of national solidarity ceases to be challenged in principle, however violent and radical the struggle over the sharing of the cake may be. Thereafter a de facto united front of the workers and capitalists of the well-to-do countries, directed against the poor nations, coexists with an internal trade-union struggle over the sharing of the loot. (Emmanuel, 1972, p. 180)

Arghiri Emmanuel is not the first to articulate this thesis, but its lack of novelty in no way diminishes its importance. What Emmanuel adds to the debate is the claim, backed by theoretical argument, that *unequal exchange* is chiefly responsible for the united front of First World workers and capitalists against the demands of the Third World. This united front, far from being an ideological mistake on the part of a propagandized proletariat, is dictated by their real, objective interests. Hence, in Emmanuel's words, "international workers' solidarity becomes an historical misconception" (1972, p. 189).

John Roemer has also addressed the question of unequal exchange. Roemer (1983) demonstrated that if the world economy is in free-trade

equilibrium, and if country X has so little capital that it must use the most labor-intensive technology, while country Y has so much capital that it may use the most capital-intensive, then X is necessarily exploited and Y is necessarily an exploiter.

This result is startling. In the model for which it is proven there is no force or fraud. Each country has traded freely with its neighbors so as to maximize its national income. Moreover, each country is assumed to have an equally skilled labor force and full knowledge of existing technologies. The only linkage between countries is liberalism's heralded instrument of progress: free trade. Yet the result is exploitation.

Roemer's analysis differs significantly from Emmanuel's. Apart from political focus, the most obvious difference is the conceptual framework. Emmanuel uses Marx's categories — constant capital, variable capital, surplus value, and the like — which are readily comprehensible and easy to employ. Unfortunately, the computations based on these categories are (necessarily, as we shall see) incorrect.

Roemer's neoclassical general equilibrium framework surmounts these difficulties. His technical analysis is mathematically sophisticated and logically flawless. However, precisely because his argument is so adroit technically, its ethical-political import is less clear.

What has Roemer *really* shown, and is it more or less than Emmanuel? What, in fact, has Emmanuel shown? These are the questions with which this article begins. In the end, I propose a synthesis, a heuristic Roemer-Emmanuel model of nations and classes that clarifies the disturbing proposition that opened this essay.¹

THE ROEMER MODEL

Roemer begins his analysis with N countries, all of which have knowledge of the same Leontief technology (A, L) , where A is an $n \times n$ non-negative input matrix and L and n -dimensional column vector of direct labor coefficients.² To grasp Roemer's argument, let us work through a specific two-country, two-sector example.

Suppose technical conditions are such that 1 bushel of wheat can be produced with 2 days labor, using $\frac{1}{4}$ bushel of wheat and $\frac{1}{8}$ ton of steel, while 1 ton of steel can be produced with 1 day's labor, using $\frac{5}{8}$ bushels of wheat and $\frac{1}{4}$ ton of steel.³ That is,

$$\begin{aligned} \frac{1}{4} \text{ wheat} + \frac{1}{8} \text{ steel} + 2 \text{ labor} &\longrightarrow 1 \text{ wheat} \\ \frac{5}{8} \text{ wheat} + \frac{1}{4} \text{ steel} + 1 \text{ labor} &\longrightarrow 1 \text{ steel} \end{aligned}$$

1. Special thanks to Patsy Schweickart, John Roemer, and the *Economics and Philosophy* referees and editors for valuable comments on earlier versions of this article.
2. Each row of A represents an industry, each column a produced commodity. A unit output of industry i requires a_{ij} units of commodity j combined with L_i units of labor.
3. The numbers here are drawn from an example from Roemer (1982a, p. 40), introduced there for other purposes.

Let us consider two countries, X and Y, with given initial stocks of wheat and steel and fixed labor forces. Let us specify that each country has exactly 100 person-days of labor to expend and that X is endowed with 25 bushels of wheat, while Y has 50 bushels of wheat and 33.3 tons of steel. Let us now set for each country the following problem: apportion your labor force between the two industries, wheat and steel, in such a way that your national income is maximized; you may trade initial stocks at world market prices to acquire the correct technical composition you need, but you may neither borrow or lend capital, nor import or export labor. Free trade alone will link your two countries.

Obviously, neither country can proceed until prices are specified, since how one chooses will depend on the relative prices of wheat and steel. Roemer requires that prices be *equilibrium* prices, but his concept of equilibrium is quite general. He requires only that prices be such that: (a) for each country to achieve its maximum income, both industries must operate (in the combined economy, although not necessarily in each country); and (b) the total wheat and steel used up in production must not exceed the combined initial stock. (As Roemer notes, more restrictions could be placed, e.g., that the initial stocks be replaced or that supply and demand balance, but such restrictions are not needed to prove his theorem.)

Given the wheat-steel technology and the initial endowments, $p = (2, 3)$ (i.e., wheat = \$2/bushel, steel = \$3/ton) is an equilibrium price vector.⁴

To see this, we observe that at these prices, it takes \$1 worth of raw materials and 2 days' labor to produce \$2 worth of wheat, and it takes \$2 of raw materials and 1 day's labor to produce \$3 worth of steel. That is, to net \$1 in the wheat industry, it takes \$1 in raw materials and 2 days' labor, while to net \$1 in the steel industry, it takes \$2 in raw materials and 1 day's labor. Clearly, it is better to produce steel if one has a large enough initial endowment to do so. Y does. Y has \$200 worth of raw materials, so it can use all its labor in steel and net \$100. X, however, has an initial endowment worth only \$50, which would supply inputs for only 25 worker-days in steel and net only \$25. If X cultivates wheat instead, its 100 days' labor would produce 50 bushels of wheat and net \$50, which, as can be readily verified, is its maximum income. Thus, we see, both wheat and steel will be produced when prices are (2, 3). Moreover, with this international division of labor, 75 bushels of wheat and 33.3 tons of steel will be used up — precisely the total initial stock.

So far, so good — but where's the exploitation? Roemer now plays a Marxian card. Given the technical conditions of production, one can, in the usual fashion, compute the quantity of labor embodied in wheat

and steel.⁵ One solves the simultaneous equations

$$\begin{aligned} \left(\frac{1}{2}\right)v_1 + \left(\frac{1}{3}\right)v_2 + 2 &= v_1 \\ \left(\frac{2}{3}\right)v_1 + \left(\frac{1}{4}\right)v_2 + 1 &= v_2 \end{aligned}$$

to get 1 bushel of wheat = 40/11 days of labor and 1 ton of steel = 48/11 days of labor. So, \$1 spent on wheat purchases 20/11 days of labor, and \$1 spent on steel purchases 16/11 days of labor.⁶ This means that X, which has expended 100 days of labor and netted \$50, can purchase *at most* 91 days' labor (the maximum occurring if it buys all wheat), whereas Y, which also expended 100 days' labor, will purchase *at least* 145 days' labor (the minimum occurring if it buys only steel). That is, no matter how X and Y spend their income, X necessarily purchases less labor than it expended, while Y necessarily purchases more.

Roemer defines exploitation as follows: a country is *exploited* if no matter how it spends its national income, it cannot purchase goods embodying as much labor as it supplied; a country is an *exploiter* if no matter how it chooses to spend its income, it will command more labor than it supplied (Roemer, 1983, p. 41). Hence, according to this definition, X is exploited and Y is an exploiter.⁷

What features of X and Y were responsible for this situation? Roemer's central theorem provides the answer. Roemer's theorem states that exploitation *necessarily occurs* whenever a country, to maximize its income, must work exclusively in the most labor-intensive industry (in which case it will be exploited) or must work exclusively in the most

5. So long as the matrix A is indecomposable, a unique solution will always exist. A will be indecomposable if there is at least one produced commodity that enters directly or indirectly into the production of all the produced commodities.

6. Notice, "to purchase a day's labor" means to purchase goods that took 1 day to produce, counting the direct labor and the labor embodied in the raw materials. It does not mean "to hire a laborer for a day."

7. Roemer's "labor-value" (LV) definition given here is identical to the Roemer (1982a, p. 121) definition of "exploitation in an accumulating economy," but not to his game-theoretic "property relations" (PR) definition of (capitalist) exploitation. The latter specifies a coalition S as exploited if (1) S would be better off withdrawing from the larger society with its per capita share of the alienable assets, (2) the complementary group S' would be worse off, and (3) S' is in a relationship of dominance to S (cf. Roemer, 1982a, pp. 194–211). The PR definition is problematic for the cases under consideration, since (3) would seem not to hold.

In Roemer (1982b, p. 285) condition (3) is replaced by (3)': if S were to withdraw from society with its *own* endowments (not its per capita share), then S' would be worse off. On this version of PR, a country that is LV-exploited is also PR-exploited. However, a country that is PR-exploited need not be LV-exploited. If X has less than its per capita share of the combined assets of X and Y, it will be PR-exploited. But if its share is only slightly less (as we shall see), it need not be LV-exploited. See also Roemer (1982a, pp. 204–05).

4. For clarity of exposition, I am introducing monetary prices. The numeraire, however, is irrelevant, since all that matters in what follows are *relative* prices.

capital-intensive industry (in which case it will be an exploiter) (Roemer, 1983, p. 42).

This result is by no means obvious. Exploitation does not follow simply from the fact that X and Y expended equal amounts of labor but produced products of unequal worth. If country Z had a labor force equal to that of X or Y, but Z were endowed with \$100 worth of raw materials, Z would apportion its labor force $\frac{2}{3}$ to wheat and $\frac{1}{3}$ to steel, netting an income of \$66. (See Roemer, 1982a, p. 41, for the computational technique.) In this case, Z is neither exploited nor an exploiter. For Z can, if it chooses to do so, purchase wheat embodying 120 days' labor, which is more than it expended. Or it can purchase all steel, embodying 97 days' labor, less than it expended.

THE EMMANUEL MODELS

Let us hold for awhile the ethical and political issues raised by this analysis, and turn our attention to Emmanuel. Here we have a different analytical framework. To facilitate the comparison, we will again assume a two-sector wheat and steel economy and two countries having labor forces of equal size and skill. We will suppose that country X specializes in wheat and country Y in steel.⁸ As we have observed, once the technology is specified, labor values can be calculated. Emmanuel, following Marx, conducts his analysis in terms of these values. Like Marx, he regards production as the interaction of living labor and "dead labor," "dead labor" being that embodied in the raw materials and equipment necessary for production.⁹

Suppose that in each industry, it takes 40 days of "dead labor" and 120 days of living labor to produce 160 units (bushels, tons, respectively) of output. Let us suppose also that 60 hours of the living labor is "paid" labor and the other 60 is "unpaid."¹⁰ This information is summarized in Table 1, where, adopting standard Marxian terminology, we let c = constant capital (the labor embodied in raw materials and equipment

8. It should be noted that in Roemer's model this specialization is demonstrated, not assumed. Roemer's income maximization requirement, the basis for the proof, is not assumed by Emmanuel. It should also be noted that much controversy surrounds the assumption that the commodities at issue be country specific. (For opposing views, see de Janvry and Kramer, 1979; and Gibson, 1980.) This article will not concern itself with that controversy. Here we are interested in a comparison of Emmanuel and Roemer and in the normative implications of free trade when products are country specific.

9. It is controversial in discussions of Marxian value theory to regard value as "embodied labor," but the criticisms raised in the value theory debates about so regarding value have no bearing on the analysis given here.

10. This Marxian formulation should be understood as follows: workers will be paid a wage, which they will spend on wheat and steel embodying a certain quantity of labor. Our supposition is that this quantity is 60 days – the value of the wage received for 120 days of work.

Table 1
Initial summary of countries X and Y

	c	v	s	V (Total Value)
X	40	60	60	160 = 160 bushels wheat
Y	40	60	60	160 = 160 tons steel

depreciation), v = variable capital (the labor embodied in the workers' wage), and s = surplus value (the difference between the labor expended during the production period and v).

To approximate international exchange in today's world, Emmanuel assumes that capital is mobile between nations, but labor is not. So, if wheat and steel are being produced, the economy will be in equilibrium only if profit rates are equal. Otherwise, capital will flow from the country with the lower rate to the country with the higher.

But how is this rate to be calculated? Usually Marxists write $r = s/(c + v)$, or, sometimes, $r = s/c$. Emmanuel's model deviates from this convention in the direction of both simplicity and realism. Capitalist production, he observes, normally involves more than simply providing workers with raw materials. Typically, production involves a much larger initial investment, and it is on this investment that the capitalist computes his profit. Wages and even raw material inputs can be financed short term, the advances repaid out of sales. What the capitalist is interested in is the return on his long-term initial investment. That initial investment we will label K . (The short-term advance, c , should be regarded as payment for the raw materials used in a given period and for the depreciation of whatever buildings and machinery were purchased with K . Hence, K does not deteriorate over time. Under conditions of equilibrium K is "eternal" – as it should be if the model is to reflect the character of capitalist investment. If the economy is in equilibrium, a share of stock will pay its annual dividend forever.¹¹)

With the model thus specified, we can now compare several cases.¹² In the first case, we assume that K is the same for both wheat and steel, say 500 for each. Thus far we have said nothing about prices. But we have set up our model so that they are now determined. As can readily be verified, when there is an "equal organic composition of capital"

11. An originator of neoclassical economics, the decidedly non-Leftist Eugen Böhm-Bawerk, supports our contention that K may be regarded as eternal. Interest, he notes, "flows without ever exhausting the capital from which it arises, and therefore without any necessary limit to its continuance. It is, if one may use such an expression in mundane matters, capable of everlasting life" (Böhm-Bawerk, 1959, p. 1).

12. In what follows, I am not concerned to reconstruct Emmanuel's argument exactly as he makes it. I am drawing on his analysis (1972, Chs. 2 and 4), but since my aim is a comparison with Roemer, I shall lay it out in a manner to facilitate the comparison.

Table 2
Four Emmanuël-style cases

	K	c	v	s	V	C	rK	r	L	p
E: Equal Capital, Equal Wages										
X	500	40	60	60	160 = 160b	100	60	12%	160	1.00
Y	500	40	60	60	160 = 160t	100	60	12%	160	1.00
E': Unequal Capital, Equal Wages										
X	500	40	60	60	160 = 160b	100	40	8%	140	0.875
Y	1000	40	60	60	160 = 160t	100	80	8%	180	1.125
E'': Equal Capital, Unequal Wages										
X	500	40	20	100	160 = 160b	60	60	12%	120	0.75
Y	500	40	100	20	160 = 160t	140	60	12%	200	1.25
E*': Equal Capital, Equal (Low) Wages										
X	500	40	20	100	160 = 160b	60	100	20%	160	1.00
Y	500	40	20	100	160 = 160t	60	100	20%	160	1.00

among industries (i.e., when the wage rate and the capital/wage outlay is the same for all), then relative prices will be proportional to relative values. Hence, value calculations (i.e., embodied labor) and price calculations are the same. If we let the constant of proportionality be 1, we can read Table 2 as being in either dollars or days of labor. Since each industry thus makes \$60 on its investment of \$500, that is, a profit rate of 12%, the system is in equilibrium.¹³ With $C = c + v =$ cost of production, $r =$ rate of profit, $L = C + rK =$ dollar-value of the output, and $p =$ price per unit, the first case is summarized in tabular form as E in Table 2. The units in this table are simultaneously dollars and days of labor.

Emmanuël now makes two key variations in this model. First, he supposes that investments are *not* equal in the two branches of production. Suppose steel requires an investment of \$1000, but wheat only \$500. Let us assume that conditions of production still require 40 days of "dead labor" and 120 days of living labor to turn out 160 units of each commodity. Let us assume that wages still purchase the product of 60 days' labor. If we require that the dollar value of the total output equal the labor value (a harmless assumption – at this stage – since we are concerned only with *relative* prices), then the equilibrium condition, which compels prices to adjust so that the return on the investment in

13. Like Roemer's, Emmanuël's notion of equilibrium is quite general. Emmanuël only requires that profit rates be equal. No attempt is made to balance inputs and outputs, and so forth, as is sometimes done in more complicated Marxian models.

steel is twice the return on the investment in wheat, gives us E' (Table 2).¹⁴

We see at once the phenomenon of unequal exchange. Since initial investments K_i are unequal, profits (rK_i) must be unequal if profit rates are to be the same. But profits will be unequal only if prices are such that a bushel of wheat exchanges for substantially less than a ton of steel – even though each embodies precisely 1 day's worth of labor.¹⁵ We can see from the table that this has happened; \$1 worth of wheat embodies 8/7 days of labor, while \$1 worth of steel embodies 8/9 days. Thus, trade will involve a flow of labor from X to Y.

This case has clear affinities with Roemer's – though, as we shall see, it differs in important particulars. Unequal exchange in both cases results from the fact that Y uses a more capital-intensive technology than X.

This case, however, is not the one that most interests Emmanuël. More significant, he thinks, is the case where unequal exchange is based on *unequal wages*. To illustrate this case, let us vary our original example, this time holding initial investments equal but allowing a wage differential of fivefold between the steel- and wheat-producing countries (by no means an unrealistic differential, indeed a rather modest one if the countries involved are First and Third World).¹⁶ Since equilibrium requires an equal rate of profit, the economy must look as in E'' (Table 2). In this case, \$1 worth of wheat embodies 4/3 hours of labor, while \$1 worth of steel embodies 4/5 hours. Again trade will involve "unequal exchange." But this time the inequality has nothing to do with technical differences, since the capital/labor ratio is the same in each country. It is due solely to unequal wages.

14. The rK_i 's are determined by the requirement that the surplus (120) be distributed in proportion to the fixed investments. From rK_i , one calculates r , L , then p . Note, however, this Marxian-style calculation is problematic, since it is not the case that an equality of monetary value and labor value in output entails a similar equality in the surplus (cf. Wolff, 1984, pp. 137–40.) Emmanuël's "miscalculation" will be discussed later.

15. Despite the differences in initial investments, the labor embodied in their products is the same. The c (= 40 in both cases) includes depreciation on the existing plant and machinery. Why would a capitalist invest \$1000 to produce 160 when he could invest \$500 and produce 160? Because prices deviate from values in such a way that his profit rate is the same in either case (cf. Gibson (1980, p. 23) for a similar view).

16. Emmanuël (1972, p. 47) estimates the differential between the most developed capitalist countries and the average underdeveloped ones to be 20:1. This figure is not far from the careful calculation by Kravis (1984, p. 27) that in 1975, the ratio of the per capita GDP in the United States to that of "class 1" nations (Malawi, Kenya, India, Pakistan, Sri Lanka, Zambia, Thailand, and the Philippines) was 11:1. (This takes into account differential purchasing power of currencies. If exchange rates uncorrected for this differential are used, the ratio is 50:1.)

ROEMER AND EMMANUEL: A COMPARISON

Let us take a closer look at Emmanuel's *E'*, setting it against Roemer's model. In both cases unequal endowment of capital results in unequal exchange. The first thing we observe is that Emmanuel's calculation involves a fudge (a fact alluded to in note 14). If prices deviate from labor values, as they must if profit rates are to equalize, then the fact that *c* is the same in wheat as in steel as *labor value* does not imply that the raw material and depreciation expenses are equal *in terms of price*. Hence, profit rates as calculated by the capitalists – that is, in monetary terms – may not be equal, even though they are equal when calculated in labor terms.¹⁷ For instance, if the *c* involved in making steel is steel and the *c* required for growing wheat is wheat, then at the prices derived in *E'*, the steel capitalist must pay \$45 for his raw materials, while the wheat capitalist pays only \$35. Costs, hence profit rates, are *not* equal, so the system is not in equilibrium.

Emmanuel's "miscalculation" is not a simple error to be readily put right. It *cannot* be corrected in models that stipulate only labor values (as do the models of Emmanuel and Marx). It can be corrected only by further specifying the actual physical inputs of raw materials, which is precisely what Roemer does.

Emmanuel's calculation is off the mark – but does this affect the point he is trying to make? Emmanuel is not unaware of the problem, but he claims that his conclusion stands (1972, p. 99, n. 33). In essence, Roemer proves him right. Roemer shows, without error, that if *Y* is better endowed with capital than *X*, and if *Y*'s income derives from steel and *X*'s from wheat, then the exchange between *X* and *Y* will be unequal.¹⁸

17. This observation is scarcely new. Borkiewicz (1907) made such an observation, ushering in the "transformation problem" debate in Marxian economics.

18. The objection might be raised that one cannot invoke Roemer to save Emmanuel, since their models use different notions of equilibrium. In Roemer's model there is no capital mobility, and hence no requirement that profit rates be equal (Emmanuel's equilibrium condition).

This objection is not fatal. If we drop the ban on capital mobility, as Roemer himself does in a later section of his article (1983, pp. 53–56), profit rates will equalize among nations, as will wage rates. However, except for the *very* poor and the *very* rich (too little capital to employ all workers, too few workers to utilize all capital), national income is unaffected. In the Roemer case we have been examining, *X* would no longer be compelled by its capital constraint to grow wheat. It could borrow sufficient capital to produce steel – but the interest *X* would pay on its loan would reduce its national income to precisely what it was before. Although they no longer have to specialize in wheat and steel, they have no reason not to. If they do so 'specialize, we have Emmanuel's case, now seen to be a special case of Roemer's more general model.

Does it follow that *X* is *exploited* by *Y*? Here we encounter a central difference between Emmanuel and Roemer. Roemer defines exploitation as a situation in which *X* cannot purchase goods embodying as much labor as it expended. Emmanuel, not so careful as Roemer on such matters, does not define the normative ground of his analysis, but his position would seem to identify exploitation with systemic unequal exchange. That is to say, exploitation is held to occur whenever commodities are exchanged on the world market at price ratios that deviate from labor-value ratios.¹⁹

This conception of exploitation, although resembling Roemer's, is not equivalent. Consider the example sketched earlier. Country *Z* has a labor force equal to *X* or *Y*, but is endowed with \$100 instead of *X*'s \$50 or *Y*'s \$200. To maximize its income, *Z* apportions $\frac{2}{3}$ of its labor force to wheat and $\frac{1}{3}$ to steel, giving it a net income of \$66. As has been noted, if this sum is spent wholly on wheat, it will purchase 120 days of labor – an excess of 20 over *Z*'s expended 100. So, according to Roemer, *Z* is *not* exploited. However, when *Z* trades with *Y*, it must exchange wheat for steel, which involves exchanging a product embodying 20/11 days' labor/dollar for one embodying 16/11 days/dollar – an unequal exchange, hence, exploitation in Emmanuel's sense.

The difference between these two notions of exploitation is significant. At bottom, Roemer's concept of exploitation rests on the normative principle that if an agent expends *x* hours of labor on a product that benefits a subset of the set of agents y_1, y_2, \dots, y_n , then *x* is entitled to receive from that set of agents products on which they expended a sum total of at least *x* hours of labor. This principle derives from the notion that if I work a certain length of time for you, then you should work a similar length of time for me. To be sure, this normative principle cannot plausibly be considered absolute, but it is not unreasonable as a prima facie entitlement claim. That is to say, in the absence of other relevant normative considerations, the principle dictates a fair arrangement; when a distribution deviates from the one this principle specifies, the deviation requires justification in terms of other, overriding, normative principles.

Emmanuel's notion of exploitation rests on a different principle: fair exchange must be an exchange of equal values, where embodied labor, not free-trade price, is deemed to be the morally appropriate measure. That is to say, if my product embodies *x* hours of labor, a fair exchange should return to me a product that embodies *x* hours. This principle,

19. This must be regarded as a prima facie principle only, since Emmanuel allows that, at least under capitalism, economic rationality requires that prices deviate from labor values when there are differing levels of capital intensity among industries or nations. However, "when a low-wage country pours away abroad the extra surplus value extracted from its own workers, this does not correspond to any sort of rationality or to any sort of progress" (Emmanuel, 1972, p. 164).

although resembling the one just discussed, is far more problematic. For nothing is said about *whose* labor is embodied in my product. Note the crucial ambiguity in the phrase "my product." If "my product" means "the product (entirely) of my labor," then the principle is essentially Roemer's. But that is *not* what "my product" means in this context. "My product" here means "the product that belongs to me." For consider: the bushel of wheat X exchanges embodies 8/7 days' labor – but not 8/7 days of X's labor. Steel is an input into wheat, so part of the labor that produced that bushel came from Y. Consider also, exchange among nations involves exchange among classes – a complication we will investigate later. Clearly a principle that fails to discriminate as to the source of labor is inadequate as normative guide. It cannot be accorded even the status of a prima facie entitlement claim. So we must judge Roemer's definition of exploitation to be superior to Emmanuel's.²⁰

If we look at the models themselves and not just at the definitions of exploitation, we observe other significant differences. This time the differences less clearly favor Roemer.

Roemer's basic model demonstrates that international trade among countries of unequal capital endowments can be exploitative, quite apart from capital or labor mobility. Having drawn this important conclusion, Roemer modifies the model, now allowing capital to flow so as to equalize profit rates. This modified model differs from Emmanuel's general model in a crucial respect. Roemer's condition that national income be maximized, taken together with the requirement that profit rates be equal, *entails that wages must be equal also*. This he demonstrates. So in Roemer's model, Emmanuel's focal case – equal capital, unequal wages – cannot occur.

The underlying reason is not hard to locate. In Emmanuel's model, a capitalist is content when his profit rate is equal to that of other capitalists. He does not try to increase his profit rate by relocating his industry to a lower wage part of the world. In Roemer's model, industries are not country specific; they may be set up anywhere. All countries have costless access to the same technologies. Thus for Roemer, but not for Emmanuel, international wage differentials are impossible.

It cannot be denied that there exists a tendency in international capitalism for capital to seek low wages, a tendency that may be more

20. Although Roemer uses the definition under examination in his unequal-exchange article, he himself has become increasingly uncomfortable with labor-value definitions of exploitation. Roemer (1982a) demonstrates the essential equivalence of his game-theoretic definition and his labor-value definition. Roemer (1982b) argues for the superiority of the game-theoretic definition, on the grounds that it renders the same verdict as the labor-value definition in central cases, but better accords with our moral intuitions when the verdicts differ. Roemer (1985) goes further, asserting that the Marxian (labor-value) concept of exploitation is no longer useful. I think Roemer is wrong in this judgment, but I won't pursue the matter here. Here I am merely arguing that Roemer's labor-value definition is superior to Emmanuel's for matters at hand.

pronounced today than when Emmanuel formulated his model. But it is equally undeniable that large wage differentials persist, differentials all out of proportion to differences in intensity or skill. Emmanuel's model allows us to examine the consequences of these differentials. Roemer's does not. To the extent that these consequences are of major ethical and political significance – and I think they are – Roemer's model, as it stands, must be judged wanting.²¹

There is another respect in which Emmanuel's model compares favorably with Roemer's. The appeal here is to simplicity. Although both models are static equilibrium models, it is much easier to see the effect of a variable shift in Emmanuel's model than in Roemer's.

Consider, for example, what is involved in studying the effect of a wage change in the two models. Consider Emmanuel's E' – Emmanuel's version of the case that concerns Roemer. What would happen if wages were to rise 50%? The effects of a wage rise from 60 to 90 can be traced effortlessly. Surplus value declines in each sector to 30; v remains unchanged. Costs rise in each industry to 130. The total surplus, which must still be apportioned 1:2, divides into 20:40. The profit rate is thus 4%, monetary values of the commodities produced 150 and 170, respectively, prices (per unit) 15/16 and 17/16.

The same problem for Roemer's model is far less tractable. Consider the earlier Roemer example. In that example, there was no capital flow, so no profit rate or wage rate was determined, but one can readily calculate that the wage rate would have to be $\frac{1}{3}$ to equalize profit rates.²²

Now ask the question that was so easily answered in Emmanuel's model. What would the price of steel be, relative to corn, if w were increased 50%? If we hold the price of corn at 2 and let w increase to $\frac{1}{3}$, we must solve, even in this quite simple case, a far more complicated equation than any arising in the Emmanuel analysis. Specifically, we must solve the quadratic equation $[100 - (25 + 25p/3 + 50)]/50 = [100p - (125 + 25p + 50)]/(100 - 33p)$.

The complexity of the equation is not a function of the parameters chosen. The root difficulty is this: the fundamental price equation for Roemer's system, $(Ap + Lw)/(1 + r) = p$, is nonlinear. That is to say, if we wish to calculate the effect on prices of a change in the wage or profit

21. To be more effective, Emmanuel's model needs some modification (as we shall see later). One might argue that Roemer's model could also be modified – in this case to allow for unequal wages. Such a modification, however, would further complicate an already less-than-transparent model. I think it is more conducive to clarifying the normative issues at hand to modify Emmanuel's model in a Roemerian direction than vice versa.

22. Given the price vector (2, 3), the condition that profit rates in wheat and steel be equal becomes the equation $[100 - (50 + 100w)]/50 = [300 - (200 + 100w)]/200$, the solution to which is $w = \frac{1}{3}$.

rate, we must solve polynomial equations of order n – always a tall order, sometimes an impossible one.²³

So Emmanuel's model is transparent, but the transparency is purchased at exceptionally high cost: the calculations are technically incorrect. Roemer's is technically sound, but exceedingly complicated, at least when analyzing certain important cases. What we need, clearly, is a model that avoids Emmanuel's mathematical inconsistencies, while preserving its basic transparency. Such a model, one hopes, will give us a better perspective on Emmanuel's provocative conclusion.

NATIONS, CLASSES, AND A NEW MODEL

A notable feature of our investigation thus far is that we have viewed the actors in the unequal exchange drama to be *countries*, countries of differing capital endowments, countries with differing wage rates. But no analysis of Marxian inspiration can rest with regarding countries as agents. Countries are composed of *classes*. An adequate theory of exploitation at the world level must take into account at least two sets of factors: differences among nations *and* differences among classes within nations.

It is a striking feature of the modern world that wage variations among countries are far greater than profit rates. As we have seen, Emmanuel's E'' is an attempt to model this phenomenon. It is an attempt that has provoked an intense debate, for the *political* implications are substantial. Emmanuel's analysis centers precisely on the interaction of class and country, and leads him to claim that international workers' solidarity has become "an historical misconception."²⁴

Emmanuel's central argument derives immediately from a juxtaposition of E and E'' .²⁵ In these two models, capital investments are kept the same in each country, so as to isolate the effects of unequal wages, which are equal in E , but unequal by a factor of 5 in E'' . Comparing E with E'' , we see that the capitalists of the two countries are unaffected.

23. The quadratic formula (familiar from high school algebra) will handle polynomials of order 2. More complicated formulas exist for orders 3 and 4, but none (apart from approximating algorithms) for orders 5 and up – as was demonstrated by the young Galois in 1832 on the eve of his premature death in a duel.

24. In a very different context, Roemer also raises doubts about international worker solidarity (1982b, pp. 295–96). He models the world as composed of three classes: capitalists, workers, and peasants. He demonstrates that, given a peasantry of a certain size, workers might be better off as they are than if they were to withdraw with their *per-capita* share. He concludes that, although the workers are not exploiters, the peasants are "unfairly treated." Roemer's analysis is quite different from Emmanuel's. The focus remains access to capital, not unequal wages.

25. Emmanuel does not give his argument in quite this form, but I think the version I am about to sketch is precisely his reasoning.

The *entire* effect of unequal exchange benefits the workers in steel at the expense of the workers in wheat. Emmanuel concludes that it is the workers of the high-wage country who exploit the workers of the low-wage country; the capitalists of neither are implicated.²⁶

However true or false Emmanuel's conclusion may be, the argument from which it is derived is unsound. The problem is the juxtaposition of E and E'' . *Why* should these two models be compared? E is a world of equal wages. E'' is one where steel wages have risen by two-thirds and wheat wages have fallen by two-thirds. If this comparison is to be meaningful, one must have a theory (or at least tell a plausible story) as to how E'' relates to E . The juxtaposition suggests that the workers of X have become worse off *because* the workers of Y have become better off. But in the absence of a theory that causally connects E and E'' , the comparison proves nothing.

It is tempting to replace E by E^* , where the latter is identical to the former, except that in the latter both steel and wheat wages are low (see Table 2). If as a result, say, of trade union strength, steel workers are able to raise their wages from 20 to 100, and if prices adjust to equalize profit rates, then E^* becomes E'' . But in this case the effect is a drastic reduction in the rate of profit, from 20% to 12%. The capitalists in both countries suffer. Workers in X are not affected.

To most Marxists and others on the Left, this conclusion is more congenial than Emmanuel's. Unfortunately, it, too, is the result of specious reasoning. The argument is an advance over Emmanuel's, since we do have a plausible story to tell concerning the transition from E^* to E'' . But some complications have been overlooked.

First of all, we notice that prices have changed. Wheat has dropped from \$1/bushel to \$.75/bushel. Steel has jumped to \$1.25/ton. Is it really true that workers in X are not affected? The fact of the matter is, we cannot say, since we don't know whether workers can still consume what they did before, given the price changes.

A second question must be asked. Why has the wheat price come down? A rise in steel wages is likely to translate into a higher price for steel. That makes sense. But why did the wheat price fall? The formal answer lies with the "harmless" condition that total dollar value be held equal to total labor value. Given this assumption, a rise in the price of steel entails a fall in the price of wheat. But this effect is by no means "harmless." To be sure, *relative* prices are unaffected by the dollar-

26. "If we recognize the equalization of profits, it must be a matter of indifference (on the economic plane, at least) to a capitalist whether he is American or Indian. And if we do not recognize the equalization of profits, he would be better off as an Indian than as an American. But it is not at all a matter of indifference to a dockworker whether he is an American or an Indian" (Emmanuel, 1972, p. 183).

value = labor-value assumption, but workers do not purchase goods at relative prices. Workers are paid a *money wage* and purchase goods at *money prices*. But if we assume that 20 and 100 represent the money wage, then there is no compelling reason for requiring that the total dollar value of the output equal total labor value. That is to say, E' is not the *only* outcome compatible with the requirement that the wage differential be 5:1 and profit rates be equal. Alternative outcomes might well lead to different conclusions as to who benefits and who loses when steel workers raise their wages.

To do justice to this important issue, we must undertake a more complicated analysis than has so far been offered. Emmanuël's framework provides a starting point, but we must make further specifications if we are to avoid his miscalculations and at the same time follow the movement of the actual products in the course of unequal exchange.

It is a guiding theme of Marxian analysis that economic categories are often fetishized, and that to understand what is really going on, one must keep in view the fact that an economy, finally, is the production and distribution of concrete material goods, the existence of which depend on the interaction of human labor and nonhuman nature. To understand what is really going on, one should keep track, simultaneously, of three distinct phenomena: monetary values (since these motivate capitalists and hence initiate the system's dynamic), concrete material things (since these constitute actual consumption and investment), and expenditures of labor (since these often ground our normative judgments). Needless to say, abstraction and simplification are essential if we are to comprehend the process, but we must be careful not to make the wrong abstractions and the wrong simplifications.

Let me sketch a model that I think is fruitful and report on some of the conclusions this model suggests. The model is Roemerian in its move to the level of material inputs, but it maintains Emmanuël's basic orientation. I will keep the model specific, since its purpose is heuristic.

Let us keep in place all the technical assumptions so far specified for E and E' . Let us continue to assume that prices are determined by costs of production. We will follow Roemer in stipulating the material composition of the inputs of the industries. We will also stipulate the material content of worker consumption and add some demand conditions. These additional specifications are as follows:

- (a) the constant capital needed in both industries is steel;
- (b) workers spend their wages wholly on wheat;
- (c) all transactions (and hence all table entries except v , which continues to be in days of labor) are made in dollars;
- (d) trade between wheat-producing X and steel-producing Y is determined by the needs of the capitalists of each country to repeat

their production processes. Specifically, X must acquire 40 tons of steel and Y sufficient wheat to cover its workers' wages.²⁷

With these specifications we are in position to study the actual movements of money, goods, and labor that result from unequal wages.²⁸ As can be readily checked, the system thus specified has two degrees of freedom remaining. One degree is removed when we designate the wage rates. Removing the other requires an important additional stipulation.²⁹

We begin with E^* , the case of equal low wages, \$20 in each country. We close the system by supposing that total labor value equals total monetary value. (Since E^* will serve as our basis of comparison, this closure condition is simply a normalizing assumption.)

Now suppose that a successful workers' struggle in Y raises the money wage from \$20 to \$100. Let us consider a number of possible responses of the economy to this disequilibrating action, each determined by two sets of power relations: the relative power between capitalists and workers within the countries, and the relative power of each country in the world market. Let us consider three such responses, designated U_i , $i = 1-3$.

In each of the three cases let us assume that the workers in X are much weaker than the workers in Y vis-à-vis their own capitalists. We will represent this power differential by keeping the wage in X at \$20. The workers in X lack the power to emulate the successful action of their counterparts in Y .

Now consider three distinct adjustment possibilities. U_1 is Emmanuël's unequal wage case E'' with his "error" of calculating c in labor values instead of dollars rectified. In this case we maintain the assumption that total dollar value equals total labor value. This is the assumption that there is no global inflation. But no inflation implies that the price of wheat must fall as the price of steel rises, which suggests a market power imbalance between X and Y . Y can raise the price of its commodity. X cannot prevent a decline in the price of its commodity.

U_2 grants more market power to X . Y raises the price of steel to compensate for its increased labor costs, but X is able to prevent the

27. I will assume *minimum* trade between the two countries consistent with this requirement. This will generate minimum unequal exchange. Prices and the rate of profit are not affected by this assumption.

28. The attentive reader will notice that I have not specified the physical composition of the fixed capital K . This, of course, could be done (the simplest specification would be to have K steel), but the gain in concreteness seems insufficient to offset the somewhat more complicated computations that this would entail. (Specifically, the rate of profit calculation would have to take into account the effect on K of price changes in its components.) The general conclusions drawn from the model are unaffected by this oversimplification.

29. See the Appendix for a more formal presentation of this model.

price of wheat from falling. This latter condition, that the price of wheat remain as before, replaces the no-inflation condition and closes the system. In this case (as in U_1) the global rate of profit necessarily falls.³⁰

U_3 increases the market power of both X and Y. Each country is able to raise its prices so as to prevent a decline in the global rate of profit.³¹ This condition, which closes the system, represents a successful inflationary counteroffensive on the part of capitalists of both countries. A portion of the gains of the workers of Y are eliminated; the real wage of the workers of X declines.

An analysis of these and other cases can be laid out in tabular form in such a manner as to track simultaneously material, money, and labor. In each case all entries can be computed from the given assumptions. Detailed tables for E^* and the U_i 's are given in Table 3. A summary of the results of all four cases is given in Table 4. In these tables, b = bushels of wheat, t = tons of steel, and d = days of labor.³²

We are now in position to consider the question, "cui bono?" If we begin with a situation of equal low wages, and then allow a disruption of equilibrium by a steelworker wage hike, the immediate effect is a fall in the profit rate in the steel industry. In the immediate short run the gains accrue wholly to steelworkers at the expense of steel capitalists. Neither workers nor capitalists in X are affected. This short run disequilibrium, of course, sets into motion a process of adjustment. Three such possibilities are U_1 , U_2 , and U_3 .

One important result of this analysis is to remove a lingering doubt about the normative relevance of Emmanuel's critique of free trade. So long as unequal exchange analysis is done solely in terms of labor values, the suspicion persists that the inequalities are not morally or politically relevant. Y may be better off than X in terms of embodied labor, but so what? Is Y better off in terms of real consumption and investment possibilities?

30. That the profit rate in U_1 is less than in E^* is readily seen. Both labor costs and gross revenue remain the same in X, but the cost of raw materials, that is, steel, has gone up. Since profit rates are the same in both countries, the conclusion follows.

31. This is not precisely correct, since the effect of inflation on K is not taken into account. If we were to let K be steel, as suggested in note 28, U_3 would be a limit case, impossible to achieve, since increasing the price of steel to regain lost profit would be offset sufficiently by the increase in the value of K that a 20% profit could never be attained. The general conclusions drawn from U_2 , however, obtain whenever inflation is sufficient to reduce total worker consumption to below the 120 bushels immediately available following the successful labor offensive in Y. Such cases can be easily constructed.

32. In each case the key calculation is that of the prices of wheat and steel, p_w and p_s respectively. Given the numerical specifications, the requirement that profit rates be equal yields $p_w - p_s = 0.5$. The remaining closure conditions are as follows: For U_1 $160p_s + 160p_w = 320$; for U_2 : $p_w = 1$; for U_3 : $160p_s - 40p_w - 100 = 100$. Thus price are: for U_1 , (0.75, 1.25); for U_2 , (1.00, 1.50); for U_3 , (1.16, 1.66).

Table 3
Four Roemer-Emmanuel synthesis cases

	K	c	r	s	Y	C	rK	r	Output	Before Trade	
										p	Has Needs
E^* : Equal Low Wages, \$Value = Labor Value											
X	500	40	20	100	160	60	100	20%	\$160 = 160b	1.00	160b
Y	500	40	20	100	160	60	100	20%	\$160 = 160t	1.00	160t
U_1 : Unequal Wages, \$Value = Labor Value											
X	500	50	20	—	160	70	50	10%	\$120 = 160b	.75	160b
Y	500	50	100	—	160	150	50	10%	\$200 = 160t	1.25	160t
U_2 : Unequal Wages, Wheat Price Maintained											
X	500	60	20	—	160	80	80	16%	\$160 = 160b	1.00	160b
Y	500	60	100	—	160	160	80	16%	\$240 = 160t	1.50	160t
U_3 : Unequal Wages, Profit Rate Maintained											
X	500	66.6	20	—	160	86.6	100	20%	\$187 = 160b	1.16	160b
Y	500	66.6	100	—	160	166.6	100	20%	\$267 = 160t	1.66	160t

In all three of our unequal-wage cases the answer is quite clear. After trade, Y is materially better off than X. In each case, Y has more wheat than X and at least as much steel to consume or invest. Yet, X and Y have equal initial endowments of capital and labor. The *only* difference between X and Y, apart from their producing different commodities, is the wage rate. This inequality, in the context of capitalist free trade, generates material inequality — an inequality that would seem to lack *any* normative justification.³³

A second conclusion to be drawn from our model: one cannot say a priori how a rise in wages in one country will affect the standard of living in another. In U_1 the successful workers' struggle in Y actually raises the consumption of the workers in X. In U_2 the consumption of the workers of X remains the same. In U_3 their consumption level falls. (For a somewhat similar result derived from a different, more abstract set of assumptions, see Gibson, 1980, p. 22.)

What about exploitation? Who is exploiting whom? Consider the case U_1 . According to Roemer's definition (which I have argued is preferable to Emmanuel's), country X is exploited and country Y is an exploiter. X's net income cannot purchase 120 days' labor, even by

33. I am not addressing here the general consequentialist justification that, all things considered, there exists no economically viable alternative that is better.

Table 3 (continued)

Before Trade	After Trade		
	Workers Receive	Capitalist Net	Net Product to Consume or Invest
Result			
X trades 40b = \$40 = 40t with Y	X \$20 = 20b = 20d Y \$20 = 20b = 20d	100b = \$100 = 100d 20b = \$20 = 20d 80t = \$80 = 80d	120b = 120d 40b + 80t = 120d
X trades 133.3b = \$100 = 80t with Y	X \$20 = 26.7b = 26.7d Y \$100 = 133.3b = 133.3d	40t = \$50 = 40d 40t = \$50 = 40d	26.7b + 40t = 66.7d 133.3b + 40t = 173.3d
X trades 100b = \$100 = 60t with Y	X \$20 = 20b = 20d Y \$100 = 100b = 100d	26.6t = \$40 = 26.6d 40b = \$40 = 40d 53.3t = \$80 = 53.3d	60b + 26.6t = 86.6d 100b + 53.3t = 153.3d
X trades 85.7b = \$100 = 60t with Y	X \$20 = 17.1b = 17.1d Y \$100 = 85.7b = 85.7d	57.2b = \$66.6 = 57.2d 20t = \$33.3 = 20d 60t = \$100 = 60d	74.3b + 20t = 94.3d 85.7b + 60t = 145.7d

purchasing all wheat; Y's income of \$150 necessarily purchases more than 120.³⁴

Which classes within the countries are exploiters and which are exploited? Assuming that a capitalist qua capitalist supplies no labor, then, according to Roemer's definition,

- (a) the capitalists in both X and Y are exploiters (since they receive income but contribute no labor);
- (b) the workers in X are exploited (since their \$20 cannot purchase 120 days' labor);
- (c) the workers in Y are not exploiters (since their \$100 would purchase less than 120 days' labor if spent wholly on steel).³⁵

34. Strictly speaking, we must modify Roemer's definition slightly to conclude that Y is an exploiter, since, if Y purchased all steel, then it would purchase exactly 120 days' labor. But if Y were to purchase all steel, it would not have engaged in any trade with X. The appropriate definition should be, "X is an exploiter if, whenever X engages in trade at equilibrium prices, its net income must purchase commodities embodying more labor than X supplied." In fact, the trade requirement is implicit in Roemer's analysis, since the proof of his fundamental theorem requires that the technology matrix be indecomposable – a condition that rules out anarchy.

35. Notice, Roemer's definition applies here counterfactually. Although workers in Y are assumed to purchase wheat with their wages, they could purchase steel, and hence are not exploiters.

Table 4

Summary of four cases: Net product to consume or invest

	Workers	Capitalists	Total Value
E*	X 20b	100b	120d = \$120
	Y 20b	20b + 80t	120d = \$120
U ₁	X 26.6b	40t	66.6d = \$70
	Y 133.3b	40t	173.3d = \$150
U ₂	X 20b	40b + 26.6t	86.6d = \$100
	Y 100b	53.3t	153.3d = \$180
U ₃	X 17.1b	57.2b + 20t	94.3d = \$120
	Y 85.7b	60t	145.7d = \$200

It can be readily checked that these results are robust. For all U_i, X is exploited, Y is an exploiter, and (a), (b), and (c) obtain.

It thus seems reasonable to conclude that First World workers do not exploit Third World workers. Wages can always be spent so as to purchase less labor than expended. And yet . . . there is something right about Emmanuel's intuition that neither his nor Roemer's definition of exploitation succeeds in capturing. For consider: even in an ideal socialist society, workers would not consume the entire net product. Marx himself was clear that a socialist economy should produce a surplus (Marx, 1959, pp. 18–19). Exploitation disappears in Marx's socialist society, not because workers consume the full value of their labor, but because they control (democratically) the disposition of the surplus.³⁶

As Marx well realizes, the surplus value produced under capitalism is not consumed unproductively by the capitalists. A significant portion is reinvested. Marx objects to capitalism not because surplus is reinvested rather than consumed by workers, but because it is reinvested according to the wrong criteria, that is, according to projections of profitability rather than according to more socially (and morally) relevant values. Capitalism's "wrong criteria" do not give wholly wrong results. The results are progressive relative to feudal criteria, although in Marx's view the results are far from optimal, at least once a certain level of social development has been attained.

With these considerations in mind our unequal-exchange cases appear rather different than when viewed through the lens of Roemerian exploitation. We realize that workers in both X and Y benefit in part from the social surplus controlled by the capitalists. This surplus is

36. I am suggesting here an interpretation of Marxian exploitation that is nonstandard, but that, I think, best accords with Marx's project. I am also suggesting, although not here elaborating, a critique of the labor-value definition of exploitation different from Roemer's.

created by the workers of X and Y. But a *far greater portion* is created by the workers of X. The real problem with unequal wages seems to be not that the workers of Y are able to consume more value than they supply (which occurs only in U₁), but that the workers of X are compelled to contribute far more to the social surplus than are the workers of Y. Neither the workers of X nor Y control this surplus, but since the workers of Y benefit at least as much from this surplus as do the workers of X while contributing far less, they benefit substantially from the effects of unequal exchange.

CONCLUSION

Let me summarize briefly and draw a final conclusion. The first three sections of this article laid out, then compared, the unequal exchange analyses of John Roemer and Arghiri Emmanuel. I concluded that although Roemer's model is logically superior to Emmanuel's and his definition of exploitation more appropriate, Roemer's model does not handle a class of cases that Emmanuel rightly regards as significant: unequal exchange driven by unequal wages.

The next section of the article concerned itself with this type of unequal exchange, taking into account the class dimension of the phenomenon. A heuristic model that combines elements of Roemer and Emmanuel was developed; it was used to investigate the questions: Who benefits from unequal exchange? Who is exploited? Who are the exploiters?

One conclusion suggested by this augmented Emmanuel model is, to me at least, particularly startling. The *political* relevance of the concept of exploitation may diverge sharply from its *ethical* relevance. It is a standard assumption of Marxian politics that the real interests of the exploited are not seriously in conflict. It is assumed that the anger and moral outrage that accompanies the recognition of oneself as exploited will eventually translate into a common project aimed at eliminating the exploitation of all who are exploited. Our analysis demonstrates that this need not be the case. It may well be the case that *even though* workers of both the First and Third World are exploited, *even though* workers of the First World do not exploit workers of the Third World, and *even though* the actions of First World workers aimed at raising their own wages have not worsened the lot of Third World workers, nevertheless, the workers of the First World still benefit substantially from unequal exchange. Hence, they may have little incentive to engage in collective political action with their Third World counterparts. This is not a conclusion I am happy to report, neither has it been established as an empirical reality. But, although conceivably offset by countertendencies, it must be regarded as a real possibility.

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APPENDIX

The equations used to compute the tables in Table 3 are as follows.

Let A be a 2×2 technical coefficient matrix. For simplicity, assume that the only nonlabor input for both steel and wheat is steel. Thus, the first column of A is $[0, 0]'$; let the second column be $[a_1, a_2]'$.

Let $L = [l_1, l_2]'$ be the column vector of labor inputs.

Let $Y = [y_1, y_2]$ be the row vector of activity levels.

Let $K = [k_1, k_2]$ be the row vector of fixed capital.

Let $W = [w_1, w_2]$ be the row vector of wages.

Let $B = [b_1, b_2]$ be the row vector of worker consumption (assumed to be only wheat).

Let $P = [p_1, p_2]'$ be the column vector of prices.

Let $V = [v_1, v_2]'$ be the column vector of labor values.

Let $r =$ the rate of profit, presumed to be equal in both sectors.

The values A , L , and Y are fixed throughout. K and W are then specified. The following variables must be calculated: V , B , P , and r .

V can be computed from the vector equation $V = L + AV$. B comes from $p_1 B = W$. There remain three variables, p_1 , p_2 , and r . The two equations, $r = [y_1 p_1 - (y_1 a_1 p_2 + w_1)]/K_1$, reduce the degree of freedom to one. The system is then closed off by one of the following conditions:

$$E^*: YV = YP$$

$$U_1: YV = YP$$

$$U_2: p_1 = p_1^0, \text{ where } p_1^0 \text{ is the price of wheat in } E^*.$$

$$U_3: r = r^0, \text{ where } r^0 \text{ is the profit rate in } E^*.$$

The volume of trade between X and Y is determined by the requirement that just enough trade take place to enable the workers to buy the wheat that their wages will purchase and the capitalists to have sufficient steel for another production cycle. The dollar value of the trade will thus be $\max(a_1 y_1 p_2, w_2)$.

The workers in each country will receive w_i in money wages, which purchase b_i bushels of wheat embodying $b_i p_1$ days of labor.

What the capitalists net depends on the trade determinant:

$$\text{Case 1: } a_1 y_1 p_2 \geq w_2$$

The capitalists of X net $[y_1 - b_1 - a_1 y_1 (p_2/p_1)]$ bushels.

The capitalists of Y net $[a_1 y_1 (p_2/p_1) - b_2]$ bushels + $[y_2 - a_1 y_1 - a_2 y_2]$ tons

$$\text{Case 2: } a_1 y_1 p_2 < w_2$$

The capitalists of X net $[y_1 - b_1 - b_2]$ bushels + $[w_2/p_2 - a_1 y_1]$ tons. The capitalists of Y net $[y_2 - a_2 y_2 - w_2/p_2]$ tons.

The net product to consume or invest is just the sum of worker consumption and capitalist profit.

It should be noted that this is a highly simplified model, the point of which is not to model realistically the real world, but to elucidate certain possibilities that I think are important to keep in mind when thinking about the morality and politics of free trade.