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Disparity in Wages but Not in Returns to Capital between Rich and Poor Countries

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Department of Economics

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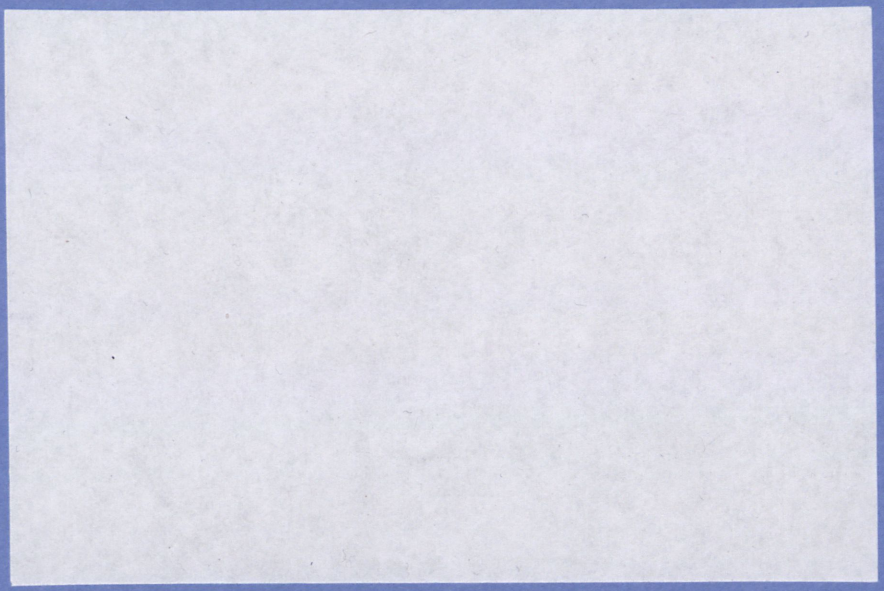

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Abstract

One of the striking features of the international economy is that while the level of average wage rates in rich countries is many times that in poor countries, their average rates of return to capital seem to be roughly similar or the differences in them relatively very small. This cannot be fully explained away by the fact that capital is internationally much more mobile than labor. There is remarkably little movement of return-sensitive private capital between the richest and the poorest countries. In this paper we assume instead that factors of production are internationally immobile, and try to explain the observed asymmetry in the pattern of factor prices in terms of particular types of differences in production functions between rich and poor countries, in terms of differential learning effects and differential degrees of specialization in the sector producing intermediate inputs and services.

Disparity in Wages but not in Returns to Capital between Rich and Poor Countries*

by

Pranab Bardhan

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I

One of the striking features of the international economy is that while the level of average wage rates in rich countries is many times that in poor countries, their average rates of return to capital seem to be roughly similar or the differences in them relatively very small. The wage disparity between, say, U.S. and South Asia, is so palpably large that any attempt to find corroborative evidence is redundant. Even for skilled labor the disparity in wages between rich and poor countries is extremely large. For example, the International Comparison Project of Kravis, Heston and Summers (1982) shows that the average wage rate for skilled blue-collar workers in six Asian developing countries (India, Pakistan, Sri Lanka, the Philippines, Thailand and South Korea) was about 9 per cent of that in seven rich countries (U.S., France, Germany, the Netherlands, Belgium, Luxembourg and Denmark); even for professional workers with post-secondary education the figure was about 13 per cent. Estimating comparable rates of return to capital between countries is a much trickier exercise, but let us refer to the results of two such heroic exercises. Harberger (1978) found the difference in the rate of return to capital between developed and developing countries very modest: for example the average private after-tax rate of return

* Valuable research assistance was provided by Rodrigo Priale on the model of section V in this paper.

to capital in the two poorest counties in his sample (Sri Lanka and Thailand) was 8.5 per cent in 1969-71, whereas it was 7.6 per cent in the richest country in his sample (U.S.). Earlier, on the basis of 1950's data, Minhas (1963) computed the rates of return to capital in manufacturing to be approximately 19-20 per cent in India and Japan, and 15-16 per cent in Canada, U.K. and U.S.

The easiest explanation of this asymmetry in the pattern of factor prices, which many including Harberger opt for, is that capital is internationally much more mobile than labor. While that is generally true, there is, however, remarkably little movement of return-sensitive private capital between rich and poor countries, certainly compared to the amounts of capital movement among rich and middle-income countries. In most of this paper I shall, therefore, stick to the assumption of international immobility of factors of production familiar from classical international trade theory, and search for explanations of the international asymmetry in factor prices between rich and poor countries under that assumption. Of course these explanations will themselves have a bearing on why capital does not flow from rich to poor countries, and in that context we shall have an occasion to comment on the answer provided by Lucas (1990) to the latter question.

The rest of the paper is organized as follows. In section II we discuss the implications of a particular type of international difference in production functions. In section III we consider the model with sector-specific factors of production. In section IV we explore the factor price implications of the average level of human capital in a country through its learning effects and through its ability to speed technological diffusion. In section V we consider the effects of differential degrees of specialization in the sector producing intermediate inputs and services on the pattern of factor prices between a rich and a poor

country.

II

Let us start with the old workhorse of international trade theory, the two-by-two Heckscher-Ohlin-Samuelson model, with the change that production functions are internationally different, as is likely to be the case between rich and poor countries. In this case, of course, factor price equalization will not hold under free trade, but under certain types of international differences in production function we can get the result that the wage rate will be higher in the rich than in the poor country while the rate of return to capital is the same between the two countries. (For a detailed algebraic and geometric derivation of this result see Bardhan (1965) and Bardhan (1970), pp. 29-38 respectively.) The intuitive idea is very simple: The rich country is technologically more advanced than the poor country, but suppose the technological gap is wider in the labor-intensive industry than in the capital-intensive industry. If factor prices between the two trading countries were the same, the labor-intensive commodity would then have been relatively cheap in the rich country. But under free trade, absent transport costs, all commodity prices have to be equal between the two countries. So factor prices have to adjust; only by letting labor to be more expensive in the rich country can the market under free trade keep the rich country producing the labor-intensive commodity at the same post-trade price as the other country.

We illustrate this in Figure 1. c_I and m_I are unit isoquants for the capital-intensive good c and labor-intensive good m respectively in the poor country I. c_{II} and m_{II} are the corresponding unit isoquants in the technologically more advanced rich country (for

simplification, we have drawn the isoquants only for the case where the production function differences between the countries are Hicks-neutral, but it can easily be checked that our result does not depend on that assumption). Under free trade prices are the same between the two countries; without loss of generality, we take those prices to be unity, so that the unit isoquants for each country lie on a common tangent. The tangents indicate the ratio of the wage rate to the rate of return to capital in the two countries, so the steeper common tangent for the rich country confirms geometrically our intuitive result in the previous paragraph that the rich country has a higher relative wage under free trade.

What about the absolute factor prices? Since OF′ is the price of either good in terms of labor in the rich country and OF the corresponding price in the poor country, taking reciprocals it is clear that the rich country has a higher absolute level of real wage. In the particular case drawn in Figure 1, OD represents the price of either good in terms of capital in both countries, and so the real rate of return is the same in both countries. (The steeper tangent can, of course, cut the capital axis above or below D, but all we want to show in Figure 1 is the possibility of its cutting the capital axis at D.)

Note that we get this result of higher real wage but the same rate of return to capital in the rich country under free trade, only for the case when the technological gap is wider in the labor-intensive than in the capital-intensive sector. If the pattern of technological gaps were different (say, the technological gap is uniform in both sectors, or larger in the capital-intensive sector), we cannot get in this model the pattern of factor prices consistent with the observed factor price differences between rich and poor countries. How plausible is the presumption of the technological gap between the rich and the poor country being wider in the labor-intensive sector?

Rigorous quantitative work on sectoral differences in production functions across countries is rather scanty. We can, however, draw some support form the evidence garnered by several people who some years back tried to test what came to be known as "the Hirschman hypothesis". Hirschman (1961) had suggested that the productivity differential between rich and poor countries is likely to be smaller in industries where the operations are largely machine-paced leaving less latitude for human operators. This hypothesis, which is clearly consistent with our empirical presumption above, received some (weak) confirmation in the work of Diaz-Alejandro (1965) comparing Argentina and U.S., of Clague (1967) comparing Peru and U.S., of Healey (1968) comparing India and U.K., and of Gouverneur (1970) comparing Zaire and Belgium.

Apart from the rationale suggested by Hirschman, one can think of at least three other kinds of reasons for the likelihood of the technological gap between rich and poor countries being wider in the labor-intensive sector. First, in a poor country usually the more "modern" sector of the economy is relatively capital-intensive, the technological distance from the industrially advanced country is relatively small with better access to new blueprints and designs, engineers working in this sector in both countries may have roughly similar training, and so on. On the other hand, the labor-intensive sector in the poor country is usually the "residual" sector, the "hold-all" for anybody who could not be absorbed elsewhere; it has a long "tail" of inefficient enterprises peopled with the army of the "disguised" unemployed scrounging for survival. Secondly, the particular sectoral pattern of inter-country technological gap is likely to be perpetuated by the nature of transfer of technology through transnational companies. Problems of private appropriability of benefits of technological improvements are usually more acute on labor-intensive production techniques -- as, for

example, suggested by Magee (1977), and, hence, transnational companies may be more interested in developing and transferring technology to the more capital-intensive sector. Thirdly, average productivity in an industry may depend on the economic life of its capital stock. If new machines embody new technology, older machines will be scrapped faster in the higher-wage country as the wages eat up the revenues from old machines requiring a larger number of workers to operate them (and faster in the latter's labor-intensive sector[1] than in the capital-intensive sector). This might bring about a larger efficiency gap in labor-intensive industries between rich and poor countries. The appropriate framework for analyzing this problem is the vintage-capital model of international trade, as in Bardhan (1965) and Smith (1976).

III

What happens if we take a Ricardo-Viner model, instead of a Heckscher-Ohlin-Samuelson model, with the non-labor factor (capital or land) specific to a sector? Suppose the production functions of the two goods are given by

$$(1) \qquad Q_i = A_i(t)F_i(\bar{K}_i, L_i) , \qquad i = c,m$$

where Q_i is output, $A_i(t)$ is a technology parameter changing over time, $\bar{K}_i$ is the amount of specific factor in sector i and L_i is the amount of the mobile factor (labor) used in i-th

[1]This is unlike in a poor country where the labor-intensive sector often includes a large informal sector with wage rates even lower than in the rest of the economy, which tend to prolong the economic life of capital.

sector. Suppose $\bar{K}_m$ is the stock of capital and $\bar{K}_c$ is the endowment of land.

From the standard calculations of the Ricardo-Viner model under competition, incomplete specialization and constant returns to scale,

$$(2) \qquad \hat{P}_i = \alpha_i \hat{W} + (1-\alpha_i)\hat{R}_i - \hat{A}_i , \qquad i = c,m$$

where $\hat{}$ represents percentage change of a variable, P_i is the unit price of the i-th good, α_i is the labor share in i-th industry, W is the wage rate and R_i is the rate of return to the specific factor in the i-th industry. If we put $\hat{P}_i = 0$ (to get the case where prices are the same between the two countries under free trade), it is possible to have the following pattern of factor prices: $\hat{R}_m = 0$, $\hat{W} = \hat{A}_m/\alpha_m > \hat{A}_m$, and $\hat{R}_c = (\hat{A}_c\alpha_m - \hat{A}_m\alpha_c)/\alpha_m(1-\alpha_c)$. In other words, in this Ricardo-Viner model it is possible to have under free trade the wage rate higher in the technologically advanced rich country, the rate of return to capital the same between the rich and poor country, and the rental rate on land higher in the poor country if the technological gap between the two countries is sufficiently wider in the industry m that uses capital compared to the industry c that uses land. This is consistent with the pattern of factor prices in some historical data: comparing Egypt with the U.S. at the turn of the century, Hansen (1991) estimates that while wages were much higher in the U.S., the real rate of return on corporate equity was about the same between the two countries, and the rent per acre of agricultural land was much higher in Egypt.

IV

Let us now consider some alternative explanations for the phenomenon of disparity in wage rates but not in returns to capital between rich and poor countries. Lucas (1990) would largely explain it by the influence (including the external effects) of the higher average level of workers' human capital in a rich country. In particular, the latter boosts the marginal product of physical capital in the rich country. But if one goes beyond the aggregative one-sector model of Lucas, our earlier discussion suggests that his explanation is somewhat inadequate. If the external effects of human capital improve the technology level of the rich country in a uniform way in the two sectors of our model in Section II, one may not still get the factor price result we are looking for, depending on the sectoral pattern of productivity improvement on account of the internal effect of human capital (for example, if the internal effect of human capital is uniform in the two sectors, the rate of return to capital will not be equalized between the rich and the poor country). If, however, we reformulate the model on the lines of Bardhan (1970), pp. 27-28, we can generate the factor price result. Following Arrow (1962), Bardhan (1970) had a model with a simple production function of the following form:

$$(3) \qquad Q_i = F_i(K_i, H^n L_i), \qquad i = c,m$$

where labor-augmenting technical progress in either sector depends on the cumulated volume of investment in the economy, H, as in Arrow's model, and n is the learning coefficient. This captures the dynamic externalities of investment (assumed sectorally symmetric). For the purpose of Lucas we can reinterpret H as the average level of human capital in the economy. Putting price equal to unit cost we can derive in the standard way:

(4) $\hat{P}_i = \alpha_i \hat{W} + (1-\alpha_i)\hat{R} - \alpha_i n\hat{H}$, $i = c,m$

where, as before, α_i is the labor share in i-th industry. Putting $\hat{P}_i = 0$ (again to get the case where prices are the same between the two countries under free trade), it is possible to have $\hat{R} = 0$ (the rate of return to capital the same) and the wage rate higher in the country with higher H (i.e. the rich country).

We can obtain a similar result if instead of the Arrow-type learning function we introduce the role of human capital in speeding technological diffusion. Suppose we replace the production function in (3) by

(5) $Q_i = (F_i(K_i, A(t)L_i)$, $i = c,m$

where $A(t) = ae^{\lambda[t-g(H)]}$, $g'(H) < 0$,

with λ as the rate at which technology advances and g as the time lag between the theoretical availability of a new technology and its adoption. The higher the stock of human capital, H, in a country, the shorter is this time lag. Again, from an equation similar to (4) we can prove that under free trade the wage rate will be higher in the rich country with a larger H, but the rate of return to capital can be the same.

V

In the recent growth theory literature productivity in final goods production has been linked with the variety of specialized inputs and services produced in the country. Ethier (1982) and Romer (1990) have formalized this old idea of the wealth of nations being

dependent on the extent of division of labor. One frequently observed difference between the production structure of a rich and a poor country is in the extent of specialization in these (non-traded) inputs and services. In this section we shall show that a capital-rich country will generate a higher degree of specialization in the domestic production of these inputs and services and this will have an effect on factor prices: even when production functions are otherwise similar between countries, the rich country will have a higher wage rate and the rate of return to capital in the poor country will be depressed. In building this model we start with the formulation in a recent paper by Rodriguez (1993), although we use it for a somewhat different purpose and derive in some ways more general results. Unlike Rodriguez (1993), we stick to our earlier assumptions of international immobility of factors of production and incomplete specialization.

Let us suppose, as before, c and m are the two final goods, and capital and labor are the two primary factors of production. But final goods production requires a composite intermediate good S (let this stand for all kinds of produced inputs, supplies, services including infrastructural facilities), which is aggregated, in the Ethier (1982) way, from a whole array of intermediate inputs:

$$(6) \qquad S_i = \left[\sum_{j=1}^{N} x_i^{\alpha}(j)\right]\frac{1}{\alpha}, \qquad 1>\alpha>0, \quad i=c,m$$

where N is the number of firms producing differentiated intermediate inputs that are imperfect substitutes of one another, and $x_i(j)$ is the amount of the intermediate good j used in the production of the final good i.

Let us, for simplification, assume that the final goods are produced with Cobb-

Douglas production functions:

$$(7) \qquad Q_i = K_i^{a_i} L_i^{b_i} S_i^{c_i}, \qquad a_i + b_i + c_i = 1, \qquad i = c,m$$

where Q_i is output of final good i, K_i is capital, L_i is labor and S_i is the composite intermediate good used in the production of i.

Like Rodriguez (1993) we shall assume that each intermediate input is produced under monopolistic competition with a decreasing average cost technology: there is a fixed requirement of one unit of capital, and each unit of $x_i(j)$ requires one additional unit of labor. Given the symmetric way in which the intermediate goods enter in the sub-production function (6), the same quantity $x_i(j)=x_i$ for all j will be produced. Since each firm in the intermediate good sector is small relative to the whole industry, the (absolute value of the) price elasticity of demand for the intermediate good can be computed as $1/(1-\alpha)$. Since the marginal cost of producing intermediate good j is equal to the wage rate, W, profit maximization by each monopolistically competitive firm in the intermediate goods sector implies:

$$(8) \qquad p_j = W/\alpha ,$$

where p_j is the price of the intermediate good j.

Solving now for S_i, the amount of the composite intermediate good and denoting by E_i the total labor hired by sector i directly (L_i) or indirectly through the use of intermediate goods (Nx_i), (7) can now be rewritten as

$$(9) \qquad Q_i = v_i N^{\phi_i} K_i^{a_i} E_i^{1-a_i}, \qquad i = c,m$$

where $\phi_i = (1-\alpha)c_i/\alpha$

and $v_i = \left[\alpha c_i/b_i\right]^{c_i} \left[1+\alpha c_i/b_i\right]^{a_i-1}$

Equation (9) shows how the degree of specialization in the intermediate inputs sector, indexed by N, affects total factor productivity in final goods production.

W_i, the cost of hiring each unit of E_i, i.e. direct plus indirect labor, is not equal to the wage rate W that a laborer gets paid. From the profit maximization conditions in the final goods sectors, using the production function given in equation (9), we can get

(10) $W_i = \gamma_i W$, $\quad i=c,m$

where $\gamma_i = (b_i+c_i)/(b_i+\alpha c_i)$, which is larger than one since $\alpha<1$.

The difference between W_i and W is on account of pure competition in final goods production and monopolistic competition in intermediate goods production. (γ_i approaches one, as α approaches one.)

From the equations for factor prices, one can derive the relationship between the relative prices of primary factors and the relative prices of final goods, depending on N, the degree of specialization of the economy, so that

(11) $\hat{P} = (\phi_c-\phi_m)\hat{N}+(a_c-a_m)\hat{w}$,

where P is the relative price of m in terms of c, w is the ratio of the wage rate to the rate of return on capital, and, as before, $\hat{}$ represents percentage change of a variable. But N is endogenous, it depends on the endowments of capital and labor and on the relative factor price w. N, which is the number of firms producing intermediate inputs, can be obtained from the condition that with free entry the long-run profits in the intermediate goods sector is zero. This condition, along with the condition of full employment of both primary factors,

yields, after some manipulation:

$$(12) \quad N = D^{-1}\left[(b_m c_c - b_c c_m)K + (a_c c_m - a_m c_c)wL\right],$$

$$\text{where } D = \left[(b_m c_c - b_c c_m)(1-\alpha) + a_c(b_m + \alpha c_m) - a_m(b_c + \alpha c_c)\right]/(1-\alpha),$$

and K and L are the endowments of capital and labor in the economy.

Now, if we assume that our sector c uses both capital and intermediate goods more intensively than sector m, i.e. $a_c > a_m$ and $c_c > c_m$, it is easy to work out that $D>0$. One can then see from (12) that the degree of specialization of the economy, N, increases with the stock of capital, K. But for saying anything definite about the relationship between N and w, we seem to need a stronger factor-intensity condition. If

$$(13) \quad a_c c_m > a_m c_c ,$$

i.e. the capital-intermediate good ratio is larger, in sector c than in sector m, then N and w are positively related. If N and w were negatively related, then from equation (11) there could be a non-unique relationship between P and w, which implies that for the same P there could be more than one equilibrium w, an outcome we want to avoid for our present purpose, like much of international trade theory. Condition (13) is, of course, a sufficient, not a necessary, condition for uniqueness of equilibrium.

Now suppose there are two countries I and II, each with its production and price structures described by equations (6) to (13), freely trading their final goods with each other (so that, absent transport costs, their final goods prices are the same). To simplify, we shall assume that both have access to the same technology so that their production functions are identical. The only difference is that one country, country II, has a larger endowment of

capital. Then the capital-rich country will in this model have a larger range of specialization in the (non-traded) intermediate goods sector (division of labor being limited by the extent of the market). This will have a differential effect on the pattern of factor prices between the two countries even when final goods prices are equalized by free trade. This is described in Figure 2.

The isoquants c_I and m_I in Figure 2 are, as in Figure 1, unit isoquants for producing c and m in the poor country I, and c_{II} and m_{II} are the corresponding isoquants for the rich country II. But now the unit isoquants of the rich country are nearer the origin, not because the rich country's production functions are superior, but because its degree of specialization in the intermediate goods sector is larger. In Figure 2, in each country the unit cost line of good c is steeper than the unit cost line of good m. This reflects the fact that in equation (10), $\gamma_c > \gamma_m$ under our assumption that sector c uses both capital and intermediate goods more intensively than sector m, i.e. $a_c > a_m$ and $c_c > c_m$. The slope of the unit cost line is $\frac{W_i}{R}$ for each country, where R is the rate of return to capital. With production functions internationally identical γ_c and γ_m are same between the two countries, so that if the wage-rentals ratio were the same, for each good the unit cost lines would be parallel for the two countries. But when free trade equalizes commodity prices, i.e. $\hat{P} = 0$ in equation (11), the wage-rentals ratio, w, has to change. The new equilibrium unit cost lines are now given by $H'T'_m$ and $H'T'_c$ in Figure 2. We can now read off the absolute factor prices from Figure 2, by looking at the reciprocals of the distances from the origin to the points where the new unit cost lines cut the capital axis (H') and the labor axis (T'_c and T'_m). It is clear

that the capital-rich country has both a higher wage rate and a rate of return to capital than the capital-poor country under free trade (without international mobility of the factors of production).

Intuitively, what is going on is something like this. The rich country has a larger domestic market for non-traded intermediate inputs and services which allows for a larger degree of specialization. This increases the productivity of both labor and capital in final goods production tending to push up both the wage rate and the rate of return to capital. This productivity change has, however, a second effect on factor prices on account of final goods prices being equalized by trade between the rich and the poor country. The productivity change, due to more specialization in the intermediate goods sector, will tend to lower the relative cost (and thus price) of good c which uses intermediate goods more intensively in the rich country. But under free trade final goods prices have to remain equal between the two countries; this is possible if factor prices adjust by lowering the wage-rentals ratio so that the relative cost of the capital-intensive good c is bolstered up. With a lower w, the capital-labor ratio will fall in both final goods sectors, lowering marginal productivity of labor and raising that of capital. So this second effect reinforces the first (positive) effect on the rate of return on capital, but counteracts with the first (positive) effect on the wage rate. In the Cobb-Douglas case discussed here and with the factor-intensity condition (13), the positive effect outweighs the negative effect on the wage rate. A high degree of factor substitutability reduces the need for large factor price adjustments and thus weakens the second (negative) effect. Condition (13) plays a role here because it implies that the difference in the intensity with which c and m use intermediate goods is lower than the difference in the capital-intensity between c and m, so that the effect of more specialization

in the intermediate goods sector in reducing the relative cost of producing c is diluted, and so the negative second effect on the wage rate mentioned above is commensurately weak.

This model provides an explanation of why the capital-rich country has a higher wage rate and why the rate of return to capital is depressed in a poor country inspite of capital scarcity. It relies on the effect of endowments and hence of market size on the domestic availability of a wide variety of specialized inputs. The model can be extended to cover the common argument that the rate of return to capital is low in poor countries on account of the absence of a well-developed and well-maintained physical and social infrastructure, particularly in power, transport, communication and job training, and if it is the case that the capital-intensive sector is more dependent on infrastructure (in many empirical studies electricity use, for example, is taken as an index of mechanization, in the absence of data on capital).

But the model in this section is clearly inadequate in fully explaining the observed factor price pattern between a rich and a poor country. For example, in this model the wage-rentals ratio is lower in the rich country, and the rates of return to capital are not (nearly) equal. Of course, one can say, among other things, we often do not have free trade between rich and poor countries. If the poor countries in general tend to protect their capital-intensive import-substitute industries, this may have an effect in raising their rate of return to capital above what is predicted in the model (apart from lowering their wage rate further). It is also unrealistic to assume as we have done in the model of this section, that the rich and the poor countries have similar production functions. Combined with certain types of differences in international production functions as discussed in sections II, III and IV above, the model is more likely to yield results on factor prices that are consistent with

wage disparity but relative similarity in the rates of return of capital between a rich and a poor country trading with each other but with factors of production immobile between them. Finally, none of the models in this paper deals with the impact of factor market imperfections[2] (for example, the possible case of labor being paid in the tradeable sectors much more than its opportunity cost in poor countries, or the case of acute information problems leading to capital rationing in poor countries) on the international pattern of factor prices.

[2]We did try to explore the implications of the popular efficiency wage theory for the international factor price pattern. If certain jobs require more commitment and responsibility and independent action but are less amenable to regular supervision and monitoring, workers on these jobs are likely to be paid a higher wage (a kind of labor rent) than on jobs with more routine, easily and closely supervised, tasks. It is plausible that the former kind of high-wage jobs are in the more capital-intensive (often also more unionized) sector and that these jobs are more important in rich rather than poor countries. One simple way to capture this intersectoral difference in labor rent may be to assume that in a standard two-sector model the wage paid in the capital-intensive sector is higher by a given absolute margin, say β, and work out how between a rich and a poor country trading with each other the factor prices will change with a larger β for the rich country. But it can be shown in this model that with a larger β while the wage rates are higher in the rich country, the rate of return to capital is even lower than otherwise. So this is not a promising line of explaining similarity in returns to capital between rich and poor countries.

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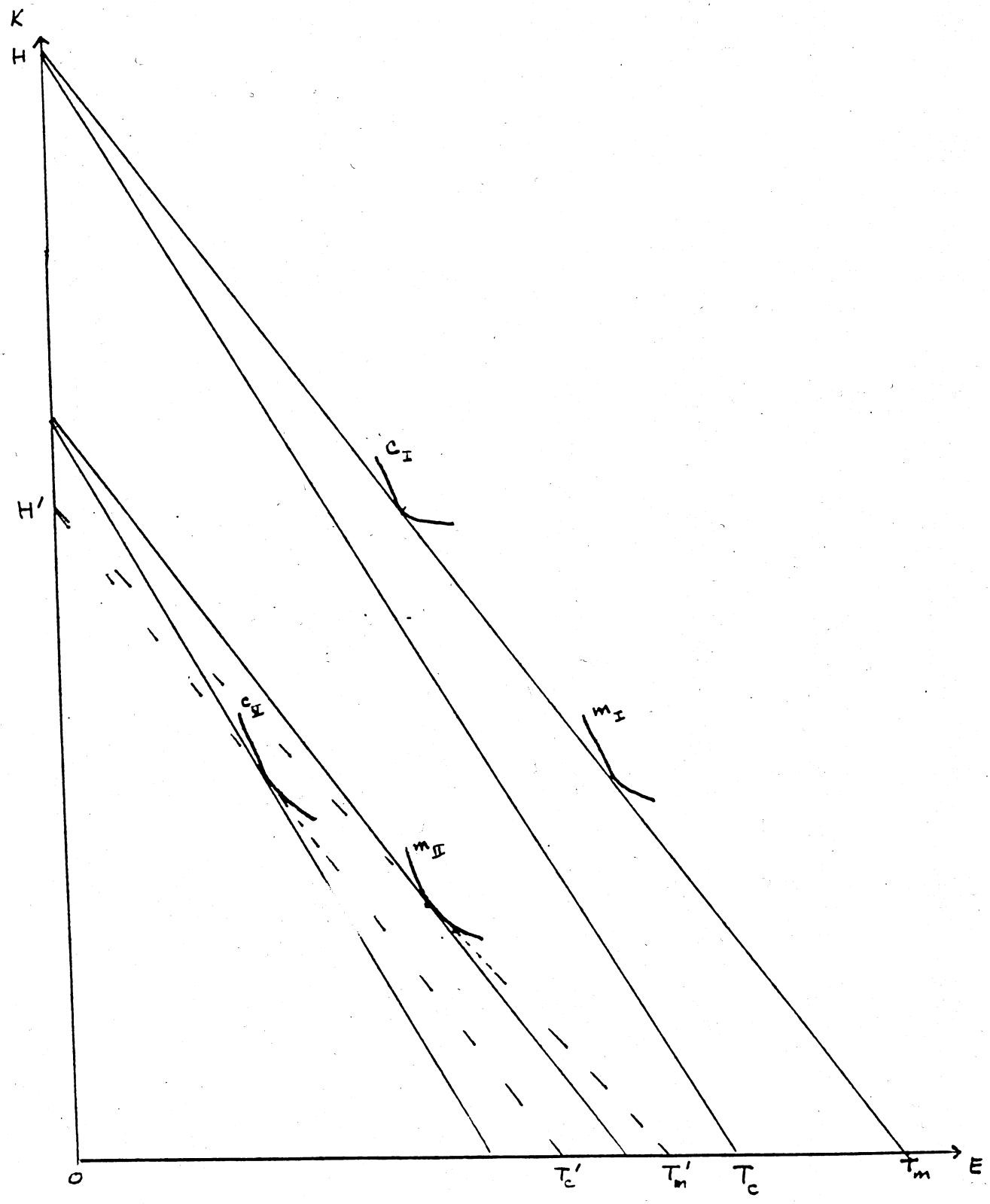

Figure 2.

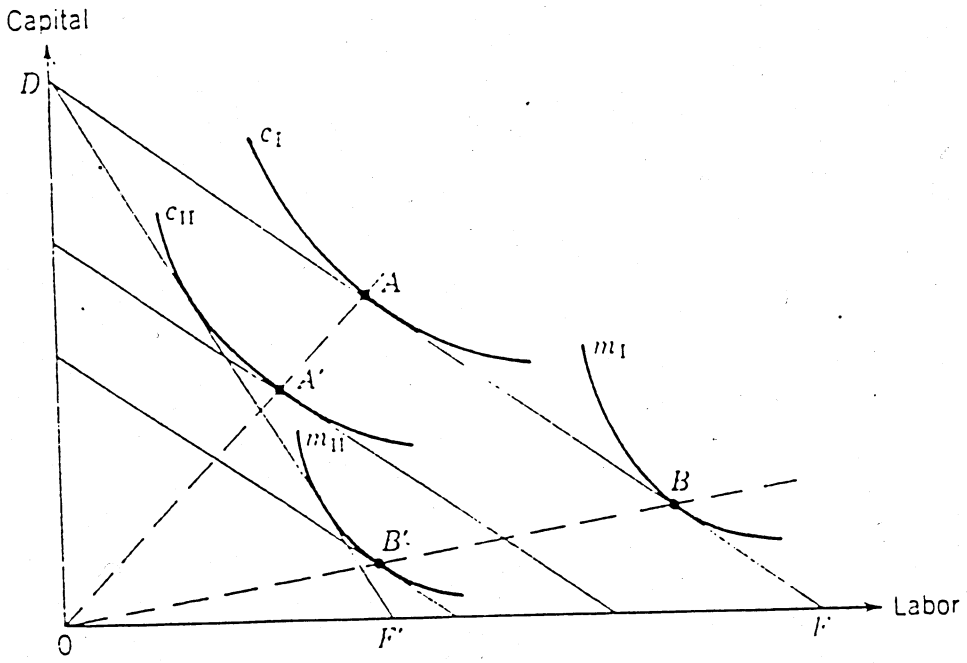

Figure 1