Impact of Property Rights in Human Capital on Regional Factor Proportions

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Let us define an economy consisting of two regions in which the following conditions exist:

(1) identical two variable (capital and labor) production functions in the two regions,

(2) perfect factor markets, and

(3) maximizing behavior by the owners of productive factors.

Under these assumptions it is a commonplace that factor proportions will adjust until they and the returns to each of the factors are equal in the two regions[1]. Such analysis can be extended with no basic change in the results to include more than two factors of production as long as the additional factors are able to move freely between the regions. However, consider the case of introducing as an additional factor of production the quantity of human capital possessed by the labor force of the two regions. The significance of human capital has been acknowledged by a variety of authors, including Schultz, Becker, Dension, Krueger, Nelson, Griliches, and Scully[2]. The general consensus of these papers effectively is that it is both

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[1] Related to this, see P. A. Samuelson : International Trade and the Equalization of Factor Prices, Economic Journal *58* (1948), pp. 163-184 and: International Factor Price Equalization Once Again, Economic Journal *59* (1949), pp. 181-197; or A. P. Lerner: Factor Price and International Trade, Economica *19* (1952), pp. 1-15.

[2] Th. W. Schultz: Investment in Human Capital, The American Economic Review *51* (1961), pp. 1-17; G. S. Becker: Human Capital, New York, 1964; E. F. Denison: The Sources of Economic Growth in the United States and the Alternatives before Us, New York, 1962; A. O. Krueger: Factor Endowments and Per Capita Income Differences among Countries, Economic Journal *78* (1968), 641-659; R.R.Nelson: Aggregate Production Functions and Median Range Growth Projections, American Economic Review *54* (1964), 575-606; Z. Griliches: Production Func-

significant and relevant to include human capital in the neoclassical produc-
.tion function. As a case in point, Scu 11y's work on regional wage differentials
in the United States argues quite strongly for the importance of human capital3.
While the case for treating human capital as a productive factor is clear, its
introduction presents complications since ownership of (or property rights
in) human capital cannot be separated from the ownership of (or property
rights in) labor itself .When labor moves in response to economic differentials,
human capital also moves. This may have the effect of necessitating a revision
in the standard theoretical conclusion that with more than two factors of
production, factor rewards and factor proportions will be equalized in the
two regions.

For discussion purposes we define the following Cobb-Douglas produc-
tion function:

$$O = aK^{\ll} H^{/J} L^{(1-\ll-/J)} \tag{1}$$

where O denotes output, K the quantity of capital employed, H the amount
of human capital utilized, and L represents the labor input. Assume that the
quantity of human capital per worker differs substantially in the two regions
due to different social policies with respect to public investment in human
capital. Therefore,

$$H_t/L_e = m \text{ and } H_l/L_l = n, \; m > n \tag{2}$$

where the subscripts i and j denote different regions.

Additionally, in line with our earlier assumptions we will assume that
productive factors will flow between the *ith* and *jth* regions until the returns
to their owners are equalized. In the case of capital this implies:

$$(o\,O/oK)_i = (o\,O/oK)_j \text{ or } (K/L)_i^{a.-l}/(K/L)_j^{a.-1} = n/J/mf1. \tag{3}$$

Since the movement of labor and human capital occurs simultaneously,
we must define a magnitude W which is equal to

$$a\,o1aL + a\,o1aH. \tag{4}$$

It is this "observed" wage rate which is of importance to the owners of
labor and human capital. Consequently, maximizing behavior implies

$$W_i = W_j. \tag{5}$$

tions in Manufacturing: Some Preliminary Results, in M. Brown (editor):.
The Theory and Empirical Analysis of Production, New York, 1967, and
G. W. Scully: Human Capital and Productivity in U. S. Manufacturing,
Western Economic Journal *8* (1969), pp. 334-340.

[3] See G. W. Scully: Interstate Wage Differentials: A Cross Section
Analysis, The American Economic Review *59* (1969), pp. 757-773 and: The
North-South Manufacturing . Wage Differential, 1869-1919, Journal of
Regional Science *11* (1971), pp. 235-252.

Performing the necessary differentiation yields

$$(KIL),"((1-\{J-a.) mP + a\{JmP-1] = (K/L)j'((1-rx.-\{J) nP + a\{JnP-1]. \quad (6)$$

From (3)

$$(KIL)\{"/(KIL\}J" = (K/L)t\ nP/(KIL)1mfl. \quad (7)$$

Substituting into (6) and simplifying produces

$$(KIL)t\ [(1-a.-\{J) +apm^{-1}] = (KIL)1[(1-a.-p) +apn-1] \quad (8)$$

or

$$(KIL)d(K/L)1=[(1-a.-\{J) +a\{Jn^{-1}]/[(I-a.-\{J\} +a\{Jm-1].$$

An examination of (3) and (8) reveals that if $(K/L)i=(K/L)f$, *m* and *n* must be equated to have equilibrium and vice versa. However, there is nothing in these relationships which necessitates that $(K/L)i = (K/L)1$ and $m= n$. In fact, it is quite possible (if not likely) that an equilibrium will be achieved in which both the capital/labor ratios and the quantity of investment per worker in human capital differ from one another by precisely the amount necessary to produce the same return to capital in the two regions as well as an equalization of the wage rates which represent the combined return to both labor and human capital[4].

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[4] Note that varying assumptions about the nature of human capital (embodied versus disembodied) does not alter our results.