Pakistan Journal of Applied Economics, (1985), Vol. IV No. 2, (93 – 100)

THE PRICE OF FOOD, LABOR SCARCITY AND THE REAL WAGE: Egypt, 1950 to 1974

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In many less developed nations, agricultural production is becoming more and more capital intensive. Some attribute this increased capital intensity to distortions in factor input prices. In this short paper an alternative explanation is developed and empirically tested. It is hypothesized that in less developed nations, where food consumption is low, as food prices rise relative to other items generally purchased by individuals in agriculture, families will find their ability to work impaired, the supply of labor will decrease, and, *ceteris paribus*, the real wage will tend to rise. Thus, some mechanization of farming activities may be due to the increased costliness of labor.

The capital intensity of production techniques in many less developed nations has become an increasing concern for many development economists. This is due to the fact that even rapid growth under these conditions will generate few new employment opportunities in countries whose populations are growing very rapidly. For example, in many developing countries the growth of manufacturing output has exceeded the growth of employment by three or four to one, [Morawitz (1984)]. Additional problems arise as a result of the high cost of imported capital, the problems of maintaining such equipment, and the excess plant capacity that often arises because of the lumpiness of capital. The capital intensity phenomenon is a characteristic of both the agricultural as well as the industrial sector in many less developed countries. In the former case, many farmers have greatly expanded their use of large tractors and other mechanized inputs.[1]

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[1] For an extensive analysis of this phenomenon, see Yudelman et al., (1971).

Much of capital intensity in production techniques has been attributed to distortions in factor input prices. More specifically, if the government subsidizes the use of tractors by making them available at artificially low prices, or by granting credit at artificially low interest rates, or by subsidizing fuel for tractors, it is logical to think that farmers would be induced to mechanize, [Binswanger (1978)]. This type of policy no doubt is at least part of the explanation as to why some farmers in less developed countries mechanize.

In this paper another explanation for the capital intensity phenomenon in agriculture will be developed and empirically tested. More specifically, it will be hypothesized that in less developed countries where food consumption levels are very low, as food prices rise relative to other items generally purchased by individuals in the agricultural sector, families will find their ability to work impaired, the supply of labor will decline, and *ceteris paribus*, the real wage will tend to rise. Thus, some of the mechanization of farming activities may be a rational response to the increased costliness of labor, resulting from the increasing scarcity of food, relative to capital.

In the first section of the paper the hypothesis will be fully developed and translated into a testable empirical model of the determinants of the real wage in the agricultural sector. In section two this hypothesis will be tested using Egyptian data for the period 1950 to 1974. Section three will summarize the results of the paper and discuss its implications.

II.

The idea that the supply of labor is dependent upon the relative availability of food is not a new one. In classical economics[2] the real wage tends in the long run to approach the natural or subsistence level, which is that level just necessary to allow the worker to reproduce himself. This follows from assuming that population growth is positive whenever the wage is above subsistence and negative when it is below. Thus, if it is assumed that food is the only good necessary for subsistence and that the relative price of food has declined, the result of perhaps the importation of cheap foodstuffs, the rise in the wage above the subsistence level would induce an expansion in population and eventually an expansion in labor supply. Thus, within the classical perspective the relative supply of food, or more generally subsistence goods, would have an impact on the supply of labor available.

More recently Gunnar Myrdal has argued that the effectiveness of labor in performing tasks is greatly affected by the level of its consumption, in particular, of food, [Myrdal (1974)]. Thus, if food becomes increasingly scarce the effectiveness of labor is likely to decline and some members of the

[2] In this paper when the term classical economics is used it refers to Ricardo (1911).

family may have to reduce their work day. As a result, the effective supply of labor will decline. Further theoretical work in this area has also been undertaken by Bliss and Stern (1978).

The hypothesis to be tested in this paper can be summarized in the following manner. In the rural areas of many less developed nations food consumption per person is already extremely low. As a result, if food becomes increasingly scarce it is hypothesized that the supply of labor will decline because labor is less capable, due to nutritional deficiencies, of undertaking as much work as previously. Thus, the real wage will tend to rise and labor will become more expensive.

The analysis outlined above is partial equilibrium in nature. One would suspect that as food became increasingly scarce, poverty presses harder, the labor participation ratios for certain age groups and females would likely increase. This would tend to offset the reduction in labor supply discussed in the previous paragraph. The extent to which it would offset the increase in labor supply would likely depend upon the extent of poverty and its intensity. The increase in labor force participation rates would likely be smaller the more extreme poverty is, i.e., the lower the average nutritional standards. Thus, for extremely poor rural areas one would expect a rise in the cost of food to reduce the supply of labor.

The hypothesis can be formalized by introducing a system of supply and demand for labor equations for the agricultural sector. Labor demand can be written as:

$$L_D = \alpha_0 + \alpha_1 (W_A/P_A) + \alpha_2 K_A + \alpha_3 T + u_1 \tag{1}$$

and labor supply as

$$L_S = \beta_0 + \beta_1 (W_A/P_A) + \beta_2 (P_F/P_G) + \beta_3 Y + \beta_4 \text{Pop.} + u_2 \tag{2}$$

with equilibrium written as

$$L_S = L_D = L_A. \tag{3}$$

The symbols used are defined as follows:

W_A = money wage in the agricultural sector;
L_A = labor employed in agriculture;
K_A = capital employed in agriculture;
T = time in terms of years;
P_F = price index for food;
P_G = an index of the cost of living in general;
P_A = an index of the cost of living in agriculture;
Y = real G.N.P.;
Pop= total population.

In the demand for labor function it is hypothesized that as real wage declines, employers hire more labor in agriculture ($\alpha_1 < 0$); as labor-using capital accumulates it is hypothesised that the demand for labor increases ($\alpha_2 > 0$); and that through time as labor-using technology becomes cheaper, so the demand for labor will rise ($\alpha_3 > 0$). On the supply side it is hypothesized that as the real wage rises, the supply of labor will increase ($\beta_1 > 0$); as the relative price of food rises it is hypothesized that the supply of labor will decline ($\beta_2 < 0$); and that as populations grow the supply of labor to agriculture increases ($\beta_4 > 0$).

Some additional comments must be made concerning using G.N.P. as a variable on the supply side. Obviously the supply of labor in agriculture is dependent upon the income earning opportunities that are available in industry. Thus, it would seem logical to include the real wage earned in industry or manufacturing as a variable on the supply side. However, reliable data concerning this variable is not available for Egypt. Therefore, a proxy variable, real G.N.P., was used. The argument is that as real G.N.P. goes up, it is likely that employment opportunities in industry will grow and it is likely that these modern sector jobs will pay higher real wages. Thus, it is hypothesized that as G.N.P. increases, the supply of labor in agriculture declines ($\beta_3 < 0$).

Egyptian data for the period 1950 to 1974 was used to test the above hypotheses. The data itself and its sources are presented in Table 1. Two stage least squares regression was used to estimate the demand and supply equations discussed above. The results are as follows:[3]

$$L_D = \underset{(2.23)^{**}}{223.042} - \underset{(-1.83)^{**}}{0.054(W_A/P_A)} + \underset{(4.19)^{**}}{0.009K_A} + \underset{(0.09)}{0.195T} \qquad (4)$$

$$R^2 = 0.72$$

$$L_S = \underset{(-0.14)}{130.528} + \underset{(1.78)^{**}}{5.361(W_A/P_A)} - \underset{(-1.50)^{*}}{798.077(P_F/P_G)} - \underset{(-3.32)^{**}}{1.280Y} + \underset{(5.29)^{**}}{0.238\ \text{Pop.}} \qquad (5)$$

$$R^2 = 0.90$$

As can be seen, the signs on all the coefficients are as was hypothesized. Most importantly, on the supply side the coefficient on β_2 is of the hypothesized sign and significant at the ten per cent level. This indicates that as the relative price of food goes up, as food becomes increasingly scarce, the supply of labor will decline and the real wage of labor will rise, *ceteris paribus*.[4] Of course, given the quality of the data and the lack of actual labor

[3] The figures inside the parentheses indicate t-ratios. **significance at 5 per cent level, *significance at 10 per cent level. This is based on a one-tail test.

[4] There may be an identification problem here. It may well be that what is happening here is the following: as the supply of labor to agriculture declines, so food production is caused to decline and the food price rises.

TABLE 1

Data base

YEAR	$(W_A/P_A)^a$	$K_A{}^b$	Pop^c	GDP^d	P_F	P_A	P_G	$L_A{}^e$
1950	147	9972	20460	1228.7	92	264	100	3307.57
1951	160	9583	20943	1251.0	100	263	107	3335.67
1952	151	9210	21437	1273.6	98	265	97	3364.41
1953	150	8850	21943	1296.7	91	269	96	3393.81
1954	114	10335	22460	1320.2	92	281	92	3423.93
1955	87	10750	22990	1344.1	93	294	92	3454.27
1956	97	10753	23532	1407.9	95	342	97	3486.30
1957	105	12086	24087	1474.8	99	339	100	3518.60
1958	114	10994	24665	1544.8	100	336	98	3552.23
1959	124	10994	25237	1618.2	101	334	99	3585.51
1960	123	10994	25832	1695.0	102	337	100	3245.00
1961	113	10994	26579	1807.9	103	358	101	3600.00
1962	112	10949	27257	1928.4	103	367	97	3600.00
1963	127	12060	27947	2056.9	105	377	99	3632.00
1964	138	13224	28659	2193.9	111	438	101	3673.00
1965	135	14500	29389	2340.1	139	519	115	3751.00
1966	170	15000	30139	2405.0	154	468	126	3857.00
1967	162	15400	30907	2471.6	152	479	128	4026.20
1968	156	15572	31693	2540.1	134	499	133	4202.80
1969	151	16962	32501	2610.5	143	536	137	4204.20
1970	138	17500	33329	2682.8	152	576	140	4120.40
1971	140	18500	34076	2761.2	160	580	144	4471.50
1972	143	18500	34839	2841.9	164	613	147	4655.70
1973	140	20036	35619	2925.0	176	661	153	4399.30
1974	155	21000	36417	3175.3	205	753	170	4197.90

Source: Data on W_A/P_A, K_A, Pop, P_A, P_G, and F were all drawn from Alan Richards, Egypt's Agricultural Development, 1880-1980 (Boulder, Colorado: Westview Press, 1982). Data for P_F and L_A were drawn from various issues of International Yearbook of labour Statistics (Geveva: ILO). For L_A, data could only be found for the years 1960 to 1974. A regession was performed for this period with agricultural employment as the dependent variable and total employment as the independent variable. This estimated equation was used to derive agricultural employment figures for the years 1950 to 1960 by using total employment figures which are available for the entire period.

[a]Real wage data for years 1954 and 1957-58 are interpolated.

[b]Number of tractors was used as the measure of capital in agriculture. Data for the years 1951-52 and 1963-64 is the result of interpolation.

[c]Population is measured in thousands.

[d]Labor in agriculture is measured in thousands.

[e]G.D.P. is in millions of 1965 Egyptian pounds. Data was only available for the years 1950, 1955, 1960, 1966, 1970, 1973 and 1975. Data for all other years was derived as a result of interpolation.

force data for some years, one should be careful in drawing any strong conclusions. Additional research needs to be undertaken in this area.

It should be emphasized, at this point, that this study ends with the year 1974. Thus, the dislocations in the economy caused by the rapid rise in oil prices and the impact of Sadat's partial loosening of economic controls are not analyzed. Also beginning in 1973, migration of workers from Egypt to other Middle Eastern countries has also become very important and thus this study does not deal with its impact on the labor supply in rural Egypt.

III.

In this paper it was hypothesized that changes in the relative price of food would affect the supply of labor and thus the real wage in agriculture. It was argued that as the relative price of food rises the ability of laborers in the agricultural sector to work will be reduced and, as a result, the supply of labor in the agricultural sector will tend to decline and the real wages rise. However, the increased scarcity of food would likely lead to increased labor force participation by certain age and sex groups and this would tend to increase the supply of labor. This latter effect is reduced the greater the degree of malnutrition. Thus, in very poor countries the overall effect is likely to be a reduction in labor supply. This hypothesis was tested by using Egyptian data for the period 1950 to 1974 and the empirical results seem to support the hypothesis.

The implications of the above are indeed interesting. In countries where food is becoming relatively scarce, the cost of labor may very well be increasing relative to the cost of capital and thus mechanization may be a rational response to increased cost of labor. Those countries where food scarcity is growing are likely to have large and rapidly growing populations. Thus, labor may be physically abundant and yet be relatively costly to hire.[5] If this is so, then eliminating factor price distortions, which were discussed in the first section of this paper, may not completely eliminate the tendency for farmers in less developed countries to mechanize.

It must be emphasized that the purpose of this paper was not to determine the extent to which mechanization can be attributed to increases in the relative scarcity and, therefore, price of food. This is a topic for future research.

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[5] For a discussion of this possibility within the context of Indian agriculture, see Rao (1972).

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