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GROUP C

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Major Determinants of the Productivity of Agricultural Labour

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Introduction

THE ultimate concern of economists is the productivity of labour. It is labour productivity which reflects the quantity of goods and services available to man for consumption. The important and varying influence of non-labour resources in determining labour productivity creates potential to raise the average productivity of labour by reallocations which lower labour productivity in some situations but provide a more than compensating increase in others. It is this phenomena which turns the attention of production economists to the complex problems of allocating a multitude of resources amongst a myriad of possible uses.

I commence my paper with this apparently naïve emphasis on the labour input because failure to recognize the underlying truth of the above propositions is the cause of much uneconomic advice and practice. This is particularly the case in low-income countries. An ultimate concern with labour productivity is equally common to high-income and to low-income countries. Likewise the complexity of allocational problems causes us to digress equally to concern with other resources in high-income and low-income nations. However, in high-income nations the very factors of economic development which rapidly enhance the material welfare of people cause rapidly rising real labour costs and place substantial emphasis directly on the processes of saving labour. This occurs even when labour is seen as simply another resource rather than as the human being with whom economic development is ultimately concerned. In contrast, in low-income countries population growth, lack of infrastructure, and the many other factors which are themselves a product of low income, conspire to maintain low incomes and low labour costs. In these circumstances there is a propensity to view labour as a free good and not to be directly concerned with problems of labour productivity.

The world's agriculture is dominated by systems in which the labour force is largely drawn from the family of the farm entrepreneur. Labour allocations and productivity in such an environment represent a complex

balance between business factors and factors of subjective personal utility. In the case of industrial labour, a number of institutional factors are likely to lead to the appearance of stepped supply and demand curves with major segments of essentially perfect elasticity. In the case of farm family labour, the opportunity for minute adjustments result in what are essentially smooth curves for both supply and demand with respectively positive and negative slopes. This paper concentrates its emphasis on the important and complex question of the productivity of farm family labour.

Definitions

Much of the confusion regarding the economics of labour productivity arises from a failure to distinguish among (*a*) labour productivity or output per unit of labour *input*; (*b*) worker productivity or output per worker, which is a function of labour productivity and the amount of labour input provided by each worker; and (*c*) labour force productivity which is a function of worker productivity and the total size of the labour force.

The individual farmer normally attaches a positive marginal utility to leisure and hence has a positive reservation price for labour. As a result he will normally not allocate labour so as to maximize worker or labour force productivity. Variation among farmers in utility schedules results in variation in productivities of labour at the margin of use as well as in worker productivity. Although one may question the propriety of such emphasis on welfare or value grounds, national governments may wish to maximize total national product even at the expense of driving the marginal productivity of labour input to zero—thereby equating labour productivity with a zero marginal utility of leisure-time activities. This provides the basis for conflict between individual and societal objectives regarding labour allocations. Economists who view the labour resources in a low-income country as having a zero marginal productivity are particularly prone to encourage policies which emphasize worker productivity or total labour-force productivity at the expense of labour productivity. Such policy emphasis creates conflict with individuals who maintain a positive reservation price for labour and demand a positive marginal product to bring their labour on to the market.

In addition to failing to give weight to positive reservation prices for leisure-time activities, economists are prone to follow accounting procedures which attach value to activities which are appraised in a money market, such as entertainment arising at the cinema or professional acting companies but not to attach value to leisure-time activities which do not enter such markets such as story telling by elders in a village society. Thus the gross gain in output through sacrifice of story telling by village elders is counted as a net gain of the same size, but a gross gain in output from sacrifice of cinema production is counted as a much smaller net gain in output. Thus the potential for conflict in individual desired allocations and those set by society is likely to be greater in traditional societies in which many of the activities sacrificed are weighted as valuable

by individuals but not by society. Such conflict is less likely in a modern society in which a higher proportion of all activities enter the market and hence are valued by economists' measures.

Determinants of labour productivity

Labour productivity is described by the two-dimensional production function which relates total output to the input of labour. The shape and position of that production function is determined by (*a*) the complement of other traditional inputs such as land and reproducible capital, and (*b*) the state of technology. In addition, the total value product function is influenced by the price of output.

The optimal quantity of complementary inputs to combine with labour is of course a further function of their relative abundance and allocation within the economy. Given the labour input, the economy-wide productivity of labour will be maximized when the stocks of these complementary resources have been allocated so as to equalize their marginal products in all uses. Due to the varying shape of the production functions for labour in various circumstances within the economy, decision concerning this allocation and hence the precise shape of the labour production function will interact with decisions concerning where one operates on the labour production function. Thus, although this determination appears to be very simple, it is in practice exceedingly complex.

The state of technology is a function of the utilization of resources in the processes of research, education, and related institutional change. The effect of technological change will rarely be simply to shift upwards the production function for labour. That would of course only change the *a* value of the function, providing more output at any given level of input but not changing the marginal values and hence not changing the optimal level of input with a given price of labour. Indeed if only such a shift were to occur in a family farm context the effect would probably be to provide a reduction in labour input as the income effect of the shift in production function caused an increase in the reservation price of labour. Rather, the effect of technological change on the production function for labour is likely to be a combination of a shift upward and an increase in the slope of the function for a considerably larger input of labour. Thus with a given price of labour, such technological change will provide incentive to increase the input of labour. In response to such change in technology, labour input will fail to increase only if concurrently the market price or reservation price of labour rises.

Means for changing labour productivity

Given the determinants of the production function for labour, it is clear that there are two means of changing labour, worker and labour force productivity. One is by moving along the production function and the other is by shifting the production function. Shifting of the production function may in turn be achieved by addition of complementary inputs or by technological change. Changing labour productivity by movement

along the production function obviously involves changes in labour input and hence an interaction between labour productivity and worker and labour force productivity. Similarly, changes in the productivity of labour due to shifts of the production function are very likely to bring about changes in the allocation of labour input and hence to have further ramifications on worker or labour-force productivity.

Labour productivity can be increased by moving to the left on the production function to a point of higher marginal product and higher average product, but of lower labour input and at the sacrifice of smaller total output. Conversely, the economy can achieve increased total production or labour-force productivity by a movement to the right on the production function. However, in that case, increase in total output will be achieved at the expense of reduction in the marginal product and the average product per unit of labour input—that is with a reduction in labour productivity. Here we can see clearly the potential conflict between labour productivity and worker or economy-wide productivity and between a national and an individual point of view.

The potential conflict between individual and national point of view may be removed if the very act of increasing aggregate labour input provides external economies which provide a compensating shift in the function. Otherwise a labour force may be induced to move out the production function and increase labour input despite a decline in labour productivity by changing its utility schedules, or causing movement down those schedules and hence increasing the utility gained from the product of work or reducing the reservation price for labour. These may in turn be achieved by programmes of exhortation, by more-attractive or less-costly consumer goods or by tax and other measures which reduce income. These points are diagrammed and discussed in detail in (2).

A change in behaviour in certain respects similar to that induced by a shift in the physical production function may be brought about by a change in the price of output. An increase in output price has the effect of increasing the value of output for any given increment of labour input and thereby, all other factors being the same, will induce an increase in labour input, an increase in total output and, of course, a decline in marginal physical productivity. The converse will, of course, hold for a decline in prices. Thus a price change influences labour input in one direction and labour productivity in the opposite direction. In traditional agricultures this can be very important because of the dominance of the labour input in the production process. Of course, the lower the marginal physical productivity of labour the less effect changes in labour input will have on output.

However, one of the factors which cannot remain the same in the face of a change in output price is the level of income of the farm family. With a higher income arising from higher output prices any family facing declining marginal utility of money income will react to the income effect by reducing its labour input. Thus the direct price effect of an increase in prices will be to encourage more labour input, the income effect will be to

discourage it. The resolution of these opposing forces depends on the shape of the utility surface and of the production surface and hence will vary among farmers. The more important family labour and the less important purchased inputs, the more important will be these labour influences of price on output. The more important cash marketings the more important will be the income effect relative to the direct price or substitution effect. Further beclouding the issue, a higher proportion of marketings is likely to be associated with a greater importance of purchased inputs, the two associated factors cutting in opposite directions.

Price changes of course influence the distribution of income and hence savings and investment as well as labour allocations. Thus optimal pricing policy is complex and subject to several complex counter influences.

The two means of shifting the production function for labour are an increase in complementary, traditional resources, and technological change. Such a shift increases the average product of labour input, and also increases income which in itself fosters decreased labour input and a further rise in labour productivity and may increase the marginal productivity of labour at any level of input thereby in itself fostering increased labour input. Again, the resolution of these forces is indeterminate without detailed knowledge of the relevant production and utility surfaces.

An increase in labour productivity in one sector through transfer of land or capital from other sectors may be at the expense of output in other sectors of the economy and thus may not achieve a net increase in output. If the allocation of non-labour resources in combination with labour was initially in equilibrium then the increase in returns to labour through more capital and other allocations to agriculture will cause a more than commensurate reduction in production in other sectors. If allocation of such resources was not in equilibrium then net output may be increased. There is also the potential to increase the quantity of non-labour resources through increased savings rates or mobilizing under utilized resources through institutional and other change. However, the potential for diminishing returns in a technologically static agriculture and external economies in the growing non-agricultural sector suggest that incremental investment may be more profitably allocated to the non-agricultural sector as long as technology in agriculture is static (3). Thus net gains in labour productivity in agriculture from increased allocation of traditional resources are usually dependent on concurrent technological change.

Technological change offers major potential for changing the position and shape of the production function, not only increasing total output and marginal productivities of labour but also in providing the incentive for an increase in the total labour input and thereby having a magnified effect on output. The extent to which such a shift in the production function through technological change will in fact cause an increase in labour input is a complex function of the change in marginal productivity of labour and the shape of the utility schedule for substitution of leisure for the products of additional labour. In addition there may be important

secondary effects of technological change through its effect on output and then on price. Empirically we observe that in most nations as technological change has occurred the benefits of increased labour productivity have been taken in part in increased material goods and services and in part as more leisure—shorter work weeks and days representing a movement to the left on the production function. This suggests that the increase in the marginal productivity of labour has been less than the decrease in the marginal utility of the product of labour at the higher income level. Nevertheless, there are occasions when the potential for increased labour input is present and visible. Likewise the use of tax and other policies may remove sufficient of the income effect of an increase in marginal productivity so that the marginal utility of such income does not decrease and added labour input results. Without such action, technological change may or may not result in increased labour input, but the final point of operation will, within the family farming context, be one of higher marginal productivity and higher average product and hence higher labour productivity. If hired labour plays an important role in agriculture and if the supply is highly elastic then labour input will increase with technological change. If there is an institutionally determined wage in agriculture which is greater than that set by natural supply and demand forces then the supply at that wage may be highly elastic. This is arguing a case within agriculture similar to that which Lewis (1) argues for the non-agricultural sector.

Within the family farming context, technological change is bound to increase labour productivity both at the margin and on the average. It is also clear that technological change may interact with production and utility surfaces in determination of the subjective equilibrium of farm family allocations of labour in such a manner as to result in no change, increase or decrease in labour input. If labour input is highly complementary with the technological change the stage may be set for rejection of the change. It is precisely in this context that labour-saving innovation may play an important positive role in the introduction of technological change even in what may appear to be a labour rich, capital poor, economy. Labour-saving innovation may raise the productivity of labour sufficiently to counter the decline in utility of the products of labour and thereby induce an input of labour complementary with new innovation. A good example of such a development would represent a new seed variety which provided lower yields at low levels of fertility and with low water-supply but which provided much higher yields with high levels of fertility and ample, well-controlled water-supply. Supply of fertilizer and water in a traditional agriculture require added labour input. Introduction of electric pumps, substituting for hand-dug wells with hand-lift methods may increase the productivity of labour to the point at which the additional labour effort will be forthcoming.

Three policy implications

Any policy or other action which depresses farm incomes will cause shifts in the utility schedule such as to encourage some increase in labour

input. The converse holds for income-increasing influences. Many influences which affect income also influence the marginal value product of labour in a way which counters the income effect. Policies which have only an income effect are fixed taxes such as land taxes and head taxes.

Changes in output prices affect both the marginal value productivity of labour and family income and hence provide contradictory forces on labour input and labour productivity. The balance of these forces will be determined by extremely complex interrelationships and will normally cause reduced labour input and hence increased labour productivity.

Like price changes, technological change has counterbalancing influences on the marginal productivity of labour and income. The net influence is likely to be an increase in labour productivity and some reduction in labour input but an increase in worker and labour force productivity.

Some empirical observations

Analysis of sources of increased agricultural production in India during the decade of the 1950s suggests that technological change has played a very minor role and increased labour input a major role (4). The data further suggest that increased production has been achieved by increased labour inputs with a relatively constant production function and hence that labour productivity declined while total production was increased. The increased poverty incident to population growth was the force that induced more labour input under these circumstances.

Similar analysis for Pakistan suggests that the relatively greater increase in irrigation investment allowed absorption of increased labour input at essentially constant or possibly even at rising productivities (5). Through 1965 it appears that irrigation investment was more important in this shift than technological change associated with fertilizer use.

In comparison of rice farms in West Bengal, India, and Kinki District, Japan, the Japanese farmers demonstrate labour input per acre nearly four times as high as for India (2). Evidence concerning Japanese wage-rates suggest that the marginal productivity of labour in Japan is considerably higher than in India. This suggests that the Japanese farmers are operating on a labour-production function quite different to that in India. Part of the difference is due to capital investment in irrigation and other facilities which facilitate a much higher double-cropping percentage. Adjusting for the double-cropping still leaves over twice the labour input per acre in Japan suggesting the influence of technological change. The much larger labour input per acre in Japan also suggests that the effect of a different production function on the marginal productivity of labour, thereby inducing a greater input of labour, has been greater than the income effect, which favours a decline in labour input. Alternatively, it is arguable that Japanese farmers have quite different utility schedules to Indian farmers. Either explanation is logically plausible.

Labour productivity in the United States has been rising sharply for many decades. Continued decline in the hours worked per year suggest that the effect of technological change in influencing the marginal productivity of labour and income has struck a balance which has resulted in taking some of the added productivity in increased money income and some in increased leisure. The configuration of demand for agricultural commodities and the supply of production inputs in the United States has resulted in a relative decline in agricultural prices which has reduced the effect of technological change on both the marginal value product of labour and family income.

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GROUP C. REPORT

IN the opening discussion several works were mentioned which indicated that the notion of a strong preference for leisure was a complex issue.[1] Generally, the results of empirical research indicated a higher utilization of potential labour time than one might expect from the works of some writers on the subject in developing countries.

The possibility of a backward sloping supply curve for labour referred to in a previous session attracted comment that if it existed it was rare, that marginal return should not fall below the cost of the calories needed for doing the work, and that in this connection agricultural economists must keep nutrition and health factors in mind.

The lack of a definition of leisure was the focus of a section of the discussion. Thus was it possible to distinguish between gossiping and negotiating a bargain? Or again, if all the time available to a worker is to be regarded as divided into work and non-work periods then it would be rational to further subdivide the non-work period into non-work that is voluntary and involuntary. Involuntary non-work situation might occur because of technical considerations relating to the job, or because of social factors—such as requirement to attend community prayers or

[1] Colin Clark (*United Kingdom*) mentioned—M. E. Beesley, 'The Value of Time Spent in Travelling: Some New Evidence', *Economica*, vol. xxxii (1965), pp. 174–85. M. R. Haswell, *Economics of Agriculture in a Savannah Village*, Colonial Office Research Serial no. 8, 1953.

participate in a wedding or a funeral ceremony. On such occasions even if there were an opportunity to do farmwork, it would not be possible to take advantage of such opportunities and the term leisure would be a misnomer. Furthermore, there was a whole range of reasons extending from the need for money to buy consumer goods to sheer boredom why people might want to work. It was suggested that it would render Professor Mellor's analytical framework more realistic if due account were taken of the degree of monetization of rural labour in the developing countries. It was not only the quantitative level of monetization that needed to be considered but also the level of sophistication with which different forms of money were used. More significantly than whether rural products were passing through the market, was whether payments of interest, rent, and wages were monetized or were paid in kind or in services, etc. The more sophisticated labour was in its use of forms of money, the more likely was a quick and significant response to quite small changes in product or factor prices and vice-versa.

Such institutional features as monopoly and monopsony in rural marketing, excessive (e.g. 100 per cent rate of interest) charges for rural credit, and high rents (above 50 per cent of production), as well as relatively inferior wages and conditions of work for rural labour were major determinants of labour productivity. Workers would only adopt new seeds, fertilizers, and improved methods of husbandry, if it were clear to them that they would be in a position to benefit from their results. Institutional change needed to be regarded as a major determinant of the productivity of labour.

Uncertainty was expressed here, as in other sessions, of the Marshallian approach for analysing farmers' economic behaviour in developing countries. The 'head and hands' approach to innovations was important in preference to attempts to persuade farmers to adopt high-cost capital inputs which they could not normally afford. The important step was to break the 'equilibrium of poverty'.

The significance of differing attitudes to work was noted. One speaker expressed the views that wealthy executives in the U.S.A. tended to work harder the higher their levels of income, in contrast with the United Kingdom where it seemed that the status symbol of wealth was to have abundant leisure.

In answer to a question whether Chinese rice farmers in Malaysia obtained relatively higher yields than Malay rice farmers in comparable conditions, it seemed that this was so. The Chinese had a very long tradition of rice-planting technology which was of high standard for their given resources. Further, with their relatively higher incomes they were better able to respond to innovations, especially in the use of insecticides and weedicides. Contrary to the popular image—and in some contrast to the Malays—Chinese farmers were not individualistic but were well organized and disciplined according to clan-dialect groups and this organization was reflected in farm operations.

Mellor, replying to another question on differing attitudes to work,

cited India and Japan as examples of the significance of cultural differences. He suggested that the availability of consumer goods as a source of motivation to earn cash wages was a further line of inquiry to be pursued. On this point Gabon in Africa was quoted where all villages were reported as having shops that contained a wide variety of consumer goods including transistor radios.

Among those participating in the discussion in addition to the opening speaker were. Colin Clark *U.K.*, G. T. Jones *U.K.*, J. Goering *U.S.A.*, U. Aziz *Malaysia*, N. Luykx *U.S.A.*, H. de Farcy *France*, J. H. Park *Korea*, E. D. Brandao *Brazil*, B. R. Davidson *Australia*, I. H. Ergas *F.A.O.*, Sherwood Berg *U.S.A.*