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MANAGEMENT AND RETURNS TO SCALE IN AGRICULTURE*

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The problem of treating management as an explanatory variable in agricultural production function has not yet been solved satisfactorily mainly because of the lack of a generally accepted cardinal measure. Only a few agricultural production function analyses are known to have included management as an explanatory variable. These investigations have specified management in different ways under a diversity of assumptions and obtained different kinds of results even with comparable situations. The objective of this article is to present a critical review of the theoretical meaning of management and of the effectiveness of different ways of treating management in empirical investigations.

I

The term management is conventionally considered as consisting of two parts: co-ordination or entrepreneurship and supervision. The existence of the firm as a decision making unit and the need for co-ordination grows out of dynamic situations, changes in factor and product prices, and other uncertainties. Important steps in co-ordination include expectation about the future, plans, action, and acceptance of consequences. If everything were known with certainty, the firm as an entity would not arise and there would be no need for co-ordination although production would still take place. Once the basic decisions about production are made, the managerial activity reduces to routine management or supervision. Therefore, co-ordination or strategic management may be taken as true management (4, pp. 67-8; 12, pp. 465-7; 19, pp. 386-405). Practically, it may be difficult to distinguish clearly between co-ordination and supervision but, theoretically, from Marshall's (21, pp. 618-24) classification of profits as consisting of two parts: normal profits or wages of routine management which enters into long-run supply price, and extraordinary profits, it follows that the premium for co-ordination or risk taking is in reality a 'quasi rent' or 'producer's surplus due to rare natural qualities.

If co-ordination implies management, under conditions of perfect competition, management may be postulated to have no specific function of decision making or it may be postulated to consist of a fixed, but not necessarily indivisible, unit for which the supply price is independent of the amount of output it controls, i.e. there is no market for management. In either case, marginal productivity of management to the firm has no meaning, therefore management should not be regarded as a specific factor of production

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from the point of view of the firm and returns to scale should be taken to reflect increase in output due to a given proportional increase of all factors except management. Alternatively, it may be postulated that each management unit if not a fixed unit performs a function more or less according to the reward which can be earned, the reward being the marginal productivity of the managerial effort. In this case, management may be considered synonymous with supervision and, therefore, must be regarded as a factor of production having a clearly defined market (26, pp. 405-6)[1].

The logic of the above arguments follows from the nature of Euler's Theorem and Cobb-Douglas production function. Theorectically, if the production function is homogeneous of degree one, under conditions of perfect competition, the profit function is also homogeneous of degree one so that the optimum scale of operation is either infinite or zero depending on whether prices result in either positive or negative profit (14, p. 15). On the other hand, institutionally determined scales of operation are found to exist in the real world and production function analysis is applied to determine, ex post, whether such scales of operation are optimal. Within the context of a Cobb-Douglas production function, determination of optimum scale requires the production elasticity of each factor input to be less than unity, i.e. all the factors are variable and marginal productivity of each factor is declining. This can happen only when at least one factor is fixed for the firm and only management in the sense of co-ordination can satisfy this condition since it cannot be increased in the same proportion as other factors (19, p. 69). Scale relationship may then be presented in the form of a two factor production function implying proportionality relationship between management as a fixed factor and all the other factors as an aggregate homogeneous variable factor. Increasing returns may prevail over a wide range of output if substantial unused capacity in management exists; decreasing returns will prevail when management capacity is reached and negative returns will ensue as size expands beyond management limit[2]. An optimizing manager would be expected to operate within the range of diminishing returns to scale.

II

Only a few agricultural production function analyses are known to have included management as an explanatory variable. In some cases, an index of residual income was used as a proxy for management assuming that between farms, within any given year, the

[1] Griliches has suggested that management should be included in the production function as a variable but returns to scale should be estimated over only 'controllable' factors which he termed 'economic returns to scale' (8, pp. 15-6). Doll also suggested the same but he preferred to call it 'returns to scale when management is fixed' (5, p. 563). However, neither of them clearly defined whether they have meant co-ordination or supervision as management.

[2] "On the one hand it appears that constant returns to scale should prevail if all factors including management could be increased by equal proportions. On the other hand, it appears that physical scale relationships should be of an increasing or decreasing nature. Decreasing physical returns to scale in agriculture are likely to be explained mainly in managerial limitations. However, the limitations fall in the realm of proportionality when a single stock of management is limited in the sense that pure supervision becomes less exacting and co-ordination (true management or choice making) becomes less perfect. When knowledge of change and the future is uncertain, management must function continuously; therefore it does become a limiting factor in the production for a single firm. Thus diminishing returns for management come about because of imperfect decisions and the corresponding misdirection of resources relative to price and production outcomes". (11, pp. 355-8, 536-7).

residual between production level estimated from a fitted function and the actually observed production levels represent the influence of management (2, 11, 27, 29). Some investigators derived an index for management by rating entrepreneurship on the basis of their knowledge of farming practices and techniques and the degree of economic rationality reflected in their current production decisions in relation to the use of recommended practices (18, 22, 28, 30). Other investigators used an index of education as a proxy for management (3, 9, 10, 15, 31). Some others attempted to eliminate management bias by combing time series of cross-sectional data and using analysis of covariance (16, 23, 24).

The diversity of assumptions under which these approaches were used may suggest that none of these methods of depicting management are realistic or satisfactory. Each method fails to show which method is more realistic than another to measure management differences.

III

The validity of the residual income approach is based on the assumption that all the other factors are paid the value of their respective marginal products which may not always be true. Moreover, residuals may not only be related to management but also to other factors such as soil characteristics, population density, public policy about agriculture, weather, disease, none of which is included in the function.

An index of entrepreneurial knowledge may not distinguish adequately between knowledge and entrepreneurial logic, thus may tend to measure managerial potential or capability rather than actual management input over the production period under investigation. Such indices also incorporate subjective elements which may vary from one researcher to another (13, pp. 225-6).

The main question concerning education as an index of management is whether or not education can stand as a proxy for management. Griliches (9,10) and Herdt (15) regarded education as an indicator of labour quality rather than a proxy for management and their findings suggest that formal education is less important in traditional agriculture than in a dynamic developed agriculture. Moreover, formal education is known to promote adverse attitude towards farming, and therefore high rates of absenteeism, in underdeveloped countries. Even when educated persons not working on farms influence those on farms to adopt new technology and inputs, relevant explanatory variables are inputs, not education because empirical production function analysis estimates, *ex post*, the productivity of factors already employed in production[3].

[3] "It does not follow that because output is related to technological advance, improvement in human agent, and improvement in the managerial skills, these should be quantified and treated as factors of production. Though, for instance, a decision to use more fertilizer does change output indirectly, it is fertilizer, not the decision, which is a factor of production. So viewed, the problem is to estimate the productivity of the factors of production which the managerial unit decides to employ. The production economist needs only to estimate the consequences of managerial decisions to employ so much of such and such conventional inputs in the conventional production of ordinary milk and corn". (17, pp. 120-3).

One of the implicit assumptions underlying the use of statistical means to overcome management bias is that a neutral shift of the entire production function takes place, either between farms or over time, due to management with no change in production elasticities anywhere along the function. While it is true that no factor in a Cobb-Douglas production function should sharply interact with any other so that the function is separable, the impact of management as suggested above almost entirely contradicts this. An a priori specification of how management might effect a production function would be through changes in production elasticities rather than by neutral shift of the entire function (28, pp, 120-1). However, Kaldor suggested that movement along a production function and a snift of the production function is empirically impossible or at least meaningless (20, pp, 212-26). Since empirical production function analysis deals, *ex post*, with factor productivities, it can explain the phenomena of movement along a production function and can also explain the nature of interaction, if any, between different production functions representing different technologies. This analytic technique cannot explain, however, the mechanism of how one function transforms into another.

IV

Even if the above shortcomings of different methodological approaches of treating management are disregarded, the almost universal finding of constant returns to scale in empirical investigations, with or without management as an explanatory variable, seems unrealistic for two reasons; one economic and the other technical. First, constant returns to scale throughout the entire range of the production function imply a horizontal average cost curve. Similarly, increasing or decreasing returns to scale throughout the entire range of the function imply respectively a decreasing and an increasing average cost curve. All three of these situations violate the necessary conditions for a stable equilibrium and contradict the implication of the conventional U or L-shaped cost curves which are the obverse counterparts of the conventional total product curve which passes through ranges of increasing, decreasing and negative returns as the scale increases (28, pp. 120-1). Second, constant returns to scale throughout the entire range imply that all the production inputs are limitational because, for given technology, output can be increased only by simultaneously increasing all inputs[4] . In reality, individual production inputs appear to be of a limitative nature because the necessity of increasing all inputs simultaneously in order to increase output is likely to be a rare occurrence[5]. The real world situation is one of proportionality relationship not only between management and other factors (recall the end part of section I above) but also among other factors themselves. Therefore, firms operating at technical and economic optimum may, in

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Myrdal crtiticised the treatment of education as a factor of production. He suggested that if investment in man were to be a factor of production at all, "it should include not only the consumption of educational and health facilities, but practically *all essential consumption*, if the underlying reasoning is to be logically consistent". (25, p. 1550). Balogh suggested that calculations made about the profitability of education are "not merely fallacious in a technical economic sense but … immoral politically". (1, p. 5).

[4] "An input is said to be limitational if an increase in its usage is a necessary, but not sufficient, condition for an increase in output". (6, p. 9: also see 7, pp. 299-300).

[5] "An input is said to be limitative if an increase in its usage is both a necessary and a sufficient condition for an increase in output" (6, p. 10).

extreme cases, approach but not quite operate at constant returns to scale. An optimizing farmer is to operate within the range of diminishing returns to scale.

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