Chapter 4

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# *Changes in Capital Productivity and Over-All Capital Problems*[1]

AGRICULTURAL ECONOMISTS are in general agreement that the United States will not need the additional product resulting from increased efficiency in southern agriculture even by 1975. Therefore, if we are concerned with efficiency of capital use and capital markets in the South, it must be because we are concerned with the low-income effects of nonoptimal use of capital or of nonoptimal functioning of the market for capital funds or capital forms.

The fourth edition of Samuelson's Economics defines capital goods as goods "produced by the economic system itself to be used as productive inputs for further production of consumption and other goods and services."[2] Embodied capital (the term capital goods is dropped because it implies tangible goods) is a productive input in the sense of adding to production in the process in which it is used. It yields its stock of services over a period of time, rather than within a given production period as some other productive inputs do. Thus, the two significant aspects of embodied capital are productivity and the time period over which the productivity effects are felt.

Among the concepts developed for understanding and analyzing the use of all productive inputs (including embodied capital) is marginal revenue productivity, or marginal value productivity. This is the (net) increment to income from using another unit of the input. In the case of land, it is the additional (net) income a farmer earns by using the last acre of a given quality in production.[3]

This concept is an important part of the production function. We take as the production function

$$Y = f(X_1, X_2, X_3 \ldots X_n)$$

with the quantities in physical terms. The marginal physical return to

[1]Published with the approval of the Director, Arkansas Agricultural Experiment Station. The author is indebted to Lloyd D. Bender, James H. White, Calvin R. Berry, and Henry J. Meenen for constructive criticisms and suggestions.

[2]Paul A. Samuelson, Economics — an Introductory Analysis, 4th ed., McGraw-Hill Book Co., Inc., New York, 1958, p. 576. Also, see Spitze's treatment of the meaning of capital in Chapter 2.

[3]In agricultural economics, MVP is sometimes computed as additional net income to the farmer's owned factors.

the ith factor will be $\frac{\delta Y}{\delta X_i}$ for the last unit of $X_i$ used. If the incremental units of Y will bring a price of $P_j$, then the marginal revenue product of $X_i$ is $P_j \frac{\delta Y}{\delta X_i}$ at the appropriate values of X and Y.

Is the production function an average of what all farmers can do? The actual production functions on which evaluations of the capital and credit situation are based are likely to have considerable normative content. The function is usually either an estimate of what better farmers can do, or an intuitive, and perhaps subconscious, estimate by the researcher of what level of productive efficiency will result in some hoped-for return. Do we consider how many low-income farmers can in fact manage to achieve the input-output relations assumed, to say nothing of the other components of farm management? It is likely that the problem is assumed away when we assume normative input-output relations, or assume without question that the Extension Service can miraculously raise management abilities substantially. Considerable investment in these human resources will be necessary before they can achieve the assumed results. This point of view is in agreement with Mackie in Chapter 22 and Woodworth and Fanning in Chapter 23.

## PUBLIC CAPITAL

Economic productivity in the aggregate and for the individual is a function of personal (or intangible) capital as well as of material capital. National product during a given time period would seem to be a function of capital investment embodied in human beings, their number, as well as of investment in stocks of material capital goods, and of the supply of natural resources. Because of the importance of technology, even the stock of natural resources at any given time is a function of cumulative past investment in human resources.[4] If investment in humans is this important, why have economists neglected it? It has not been completely neglected. Students of economic development from Adam Smith to John Rae to Kenneth Galbraith have discussed this form of investment, but no one has succeeded in developing a precise mathematical model. No easily applied criteria have been developed for determining the optimum amounts of such investments, to say nothing of the allocation of optimum amounts among different claimants.

Another possible reason why human investment has not received as much attention in the United States is that it has only grown into such vital importance since 1900. That is to say, the level of investment was not far below optimum until after the beginning of the twentieth century (considering all known technology as of the point in time).[5] The

[4] Technically, natural materials were always on hand but either were not discovered or their value was not recognized until changes in technology took place.

[5] It is perhaps more accurate to say that even the increased rate of human capital formation in recent years was not large enough to provide for optimum combinations of factors.

present emphasis on trained manpower is illustrated by estimates of future manpower needs in terms of skill and training. Mackie documents this trend in Chapter 22.

There are other than economic reasons for making some of the more important types of investment in human resources. This is especially the case for investments in education and health. As long as other reasons led decision-makers to choose levels of investment that were reasonably near the optimum, there was no practical economic problem. Now that deviations from optimum seem to be large and significant, investment in the human resource has become a factor limiting the rate of economic growth.

Research shows that increases in the volume of inputs used in production (conventionally measured) do not account for a very large proportion of the growth in total output since about 1910. Among writers on the subject, there is considerable agreement that such intangible factors as education and training, health, research, and similar factors are responsible for a good deal of the unexplained growth in output.[6]

Two ways that investment in human resources affect economic growth are mentioned briefly. Economic growth is associated closely with the rate of development of technology; this in turn is a function of investment in education and research. The effectiveness of investment in research is reduced if investment in education is not adequate. The division of expenditures between basic and applied research needs also to be optimum in order to maximize the effect on economic growth of a given investment in human resources.

Economic growth is also closely linked to the rate of adoption of developed technology. This rate is certainly affected by investment in education. Both quantity and quality of educational investment would be among the determinants of adoption rates, and of course there are other factors. Basically, the problem with low-income farmers seems to be that of increasing their learning rate enough to enable them to cope with rapid flows of technical information (cf. Chapters 22 and 23).

Information is available on state differentials in levels of investment in human resources. Several kinds of state data on investments in human resources are presented in Table 4.1. These data indicate rather dramatically that investments in the human agent (particularly in youth) are quite low in the South Atlantic, East South Central, and to a slightly lesser degree in the West South Central states. Low levels of human investment are associated with high rates of rejection by Selective Service. Data on the percentages of income going to higher education and local schools show that most of the southeastern states are slightly above the national average and are well below the percentages of the leading states. From these and other data it is apparent that marginal productivity of public investment (particularly in the

[6] For a full discussion of the role in productivity of human, social, and community capital; for tentative definitions; and for references on the subject, see Lee R. Martin, The Use of Federal Credit for Human Capital Formation, memorandum prepared for the Commission on Money and Credit, 1960, Chapter ii, Section C.

Table 4.1. Investments in Human Resources, by States

| State | Current public expenditure per pupil in average daily attendance, 1958-59 | Number of days attended per pupil enrolled, 1953-54 | Ratio of 1953-54 total enrollment[a] to school age population, 1953 | Ratio of total 1956 college enrollment to high school graduates, 1954 | Per capita public expenditures for health and hospital, 1957 | Percentage of total personal income going as public expenditure for higher education and local schools, 1957 | Percentage of selective service registrants examined who failed the mental test, 1958 |
|---|---|---|---|---|---|---|---|
| | (Dollars) | | | | (Dollars) | (Percent) | (Percent) |
| Delaware | 420 | 158 | 0.97 | 2.5 | 17 | 3.2 | 22 |
| Maryland | 366 | 164 | 0.95 | 3.0 | 20 | 3.5 | 24 |
| District of Columbia | 434 | 149 | 0.95 | 11.3 | 36 | 1.8 | 27 |
| Virginia | 245 | 160 | 0.89 | 2.0 | 14 | 3.9 | 32 |
| West Virginia | 225 | 157 | 0.88 | 1.5 | 9 | 3.9 | 26 |
| North Carolina | 220 | 162 | 0.89 | 1.6 | 13 | 4.8 | 35 |
| South Carolina | 215 | 152 | 0.87 | 1.8 | 14 | 5.5 | 58 |
| Georgia | 208 | 157 | 0.89 | 2.0 | 19 | 4.4 | 42 |
| Florida | 295 | 155 | 1.00 | 2.5 | 19 | 3.8 | 34 |
| Alabama | 164 | 154 | 0.89 | 1.6 | 11 | 4.1 | 43 |
| Mississippi | 181 | 143 | 0.91 | 1.9 | 11 | 4.9 | 46 |
| Tennessee | 205 | 156 | 0.89 | 2.2 | 15 | 4.1 | 31 |
| Kentucky | 205 | 149 | 0.87 | 2.2 | 10 | 3.6 | 33 |
| Arkansas | 201 | 149 | 0.86 | 1.3 | 10 | 4.4 | 38 |
| Louisiana | 330 | 159 | 0.92 | 2.7 | 16 | 5.2 | 44 |
| Texas | 308 | 152 | 0.87 | 3.0 | 11 | 4.5 | 20 |
| Oklahoma | 279 | 159 | 0.94 | 2.3 | 12 | 5.3 | 10 |
| New Mexico | 390 | 151 | 0.95 | 2.6 | 17 | 6.2 | 19 |
| Colorado | 355 | 149 | 1.01 | 3.3 | 17 | 5.0 | 9 |
| Wyoming | 435 | 145 | 1.03 | 1.8 | 25 | 5.7 | 6 |
| Montana | 373 | 162 | 0.94 | 1.8 | 13 | 5.2 | 4 |
| Idaho | 270 | 155 | 0.92 | 1.5 | 16 | 4.8 | 5 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Utah | 280 | 158 | 0.96 | 3.3 | 13 | 5.9 | 9 |
| Nevada | 410 | 144 | 1.18 | 1.8 | 31 | 3.8 | 15 |
| Arizona | 332 | 141 | 0.96 | 3.8 | 12 | 5.9 | 20 |
| California | 390 | 174 | 1.00 | 4.1 | 24 | 4.6 | 15 |
| Oregon | 413 | 157 | 0.97 | 2.5 | 16 | 5.2 | 4 |
| Washington | 375 | 155 | 0.99 | 2.5 | 23 | 4.7 | 5 |
| Kansas | 330 | 150 | 1.06 | 2.4 | 17 | 4.9 | 6 |
| Nebraska | 290 | 158 | 0.98 | 2.2 | 14 | 4.1 | 7 |
| South Dakota | 333 | 160 | 0.92 | 2.0 | 8 | 5.4 | 9 |
| North Dakota | 310 | 160 | 0.88 | 1.8 | 14 | 5.5 | 8 |
| Minnesota | 358 | 158 | 0.96 | 2.4 | 23 | 5.4 | 6 |
| Iowa | 346 | 159 | 1.01 | 1.9 | 14 | 4.9 | 4 |
| Missouri | 335 | 156 | 0.99 | 2.6 | 14 | 3.3 | 14 |
| Illinois | 410 | 164 | 0.97 | 2.7 | 18 | 3.2 | 16 |
| Wisconsin | 360 | 161 | 0.95 | 1.9 | 19 | 3.9 | 8 |
| Michigan | 376 | 167 | 0.98 | 2.8 | 24 | 4.7 | 12 |
| Indiana | 325 | 154 | 1.00 | 2.3 | 16 | 4.3 | 10 |
| Ohio | 330 | 160 | 0.99 | 2.4 | 15 | 3.5 | 11 |
| Pennsylvania | 370 | 165 | 0.96 | 2.0 | 15 | 3.2 | 13 |
| New Jersey | 463 | 160 | 1.02 | 2.0 | 19 | 3.1 | 20 |
| New York | 535 | 157 | 1.06 | 3.3 | 32 | 3.5 | 21 |
| Connecticut | 380 | 162 | 1.02 | 3.0 | 23 | 3.2 | 18 |
| Rhode Island | 380 | 155 | 0.99 | 4.0 | 18 | 2.9 | 17 |
| Massachusetts | 375 | 159 | 0.98 | 3.4 | 31 | 2.9 | 12 |
| Vermont | 305 | 160 | 0.89 | 2.8 | 15 | 4.7 | 13 |
| New Hampshire | 326 | 158 | 0.98 | 2.8 | 23 | 3.7 | 8 |
| Maine | 255 | 166 | 1.00 | 1.5 | 13 | 3.7 | 14 |
| United States | 340 | 159 | 0.96 | 2.6 | 19 | 4.0 | 21 |

Source: Lee R. Martin, Economic Development and Investment in Human Resources, unpublished manuscript, Tables 17, 18, 20, 21, 23, and 11.

[a]Enrollment in public and private schools.

human agent) in the South is quite high. With slightly greater sacrifices than other states are now making, low-income states could bring their human capital much nearer the optimum.

## PRIVATE CAPITAL

Several characteristics of the existing structure of agriculture are very important in the problem of obtaining optimum combinations of factors, including capital in all forms. Institutions for separating provision of capital funds from decision-making are not as fully developed in agriculture as they are in manufacturing, trade, insurance, transportation, communications, and mining. In farming, with only a few important exceptions, these two functions (providing capital and management) are performed by the same individual. Considerable tenancy remains in agriculture, but it is still regarded as a step on the way to full ownership, particularly by tenants themselves. The volume of cash renting is increasing—largely in the form of renting additional land to supplement land owned. Hiring custom services is now more important in agriculture and is another capital-saving device for farm operators.

Finally, vertically integrated systems including farm production have developed rapidly in broilers, table and hatching eggs, turkeys, feeder pigs, and processing vegetables, among others. However, this device has not been used so much to enable management to be separated from the provision of capital as it has to remove most of both functions from the farm. For example, broiler growers furnish production labor, a little capital and management, and bear some, but not all, of the risks associated with the market.

By and large, farming is still characterized by having management and ownership of the farm's resources in the same individual. This functional rigidity magnifies the importance of investment in those human agents who own the material farm capital. Failure to invest adequately in even 10 percent of the farm resource owners will affect resource use efficiency and incomes of the farm resource owners themselves. When the human capital embodied in the farm resource owners in the South is inadequate for more than half of them (as the author believes), then the implications become much more serious, particularly for the underprivileged group itself and for that region having more than its share of underprivileged managers.

As far as getting the optimum quantities and forms of capital under the control of farm operators is concerned, estimates of capital productivity on farms must be worked out for the combination of farm operator and physical resources under his control. Any mechanical estimates of productivity of physical resources by themselves are likely to be far wide of the mark in the southeastern states. Lending agencies in these states are likely to be ultraconservative in making farm loans because of the difficulty in judging the quality of the human factor in the production relationship. Because of the great importance of the

quality of the human factor, the a priori probability may be small for selecting a combination of farm and farmer for whom the combined marginal value productivity of capital would be high enough to justify investment of capital funds. In low-income areas this situation is likely to lead to rules of thumb (in terms of collateral, etc.) that do not give the really competent individual with few resources the same opportunity to become a decision-maker that good managers have in the nonfarm sectors.

Even when average capital productivity in a given area is relatively high, the lending agency cannot average out the high returns possible for good managers with the negative returns for managers who only appear to be good. An unsubsidized lender must be very successful in a low-income area, or else he will become bankrupt.

In the past, the Extension Service and other educational agencies in agriculture operated on the philosophy that a farm operator with a moderate amount of potential for management could, by means of intensive technical assistance, be brought to a level of efficiency that could be maintained with information flowing normally through established communications channels. The flow of new technical agricultural information has become so large and steady—and often so complicated—and the income penalties for not operating farms near the economic optimum so great that many farmers in low-income areas may not be able to operate a large resource bundle efficiently. Farm situations lending themselves to piped-in management are already becoming parts of vertically integrated systems. Situations not adaptable to piped-in management require decision-makers representing enough human capital that they can, with extensive assistance from the Extension Service and other agencies, obtain and interpret the flow of relevant technical information well enough to make near-optimum economic and technical decisions.

One field of science relevant to farm decision-making is learning theory, (cf. Chapter 20). For an individual decision-maker, the vital factor is the rate at which he learns. During a period of gradual change in technology and culture, the required learning rate may not be very high. In a period of rapid change, the essential learning rate grows in several dimensions. Not only do the volume and nature of information change rapidly, but information channels themselves are in a state of flux. Criteria for selecting the relevant information change drastically. The practical simplifications (rules of thumb) that proved so helpful in a more static period become useless and confusing. Techniques for optimum application of the relevant information grow in complexity. How can an individual achieve the required learning rate? Success in formal education requires a certain rate, and once acquired, this ability to learn at a given rate can be maintained and perhaps made more effective by continued application to flows of information from all sources.

It is only a slight oversimplification of our farm situation to state that the technological revolution increased considerably the learning

rate that is essential for farmers to make near-optimum decisions. Are there not a large number of farmers (especially in the South) whose formerly satisfactory learning rate is now inadequate? On their own, these farmers have not been able to step up their learning rate enough and no completely effective means for helping them has been developed. Even the lack of motivation to change (pointed out so sharply and frequently by sociologists) may be a psychological reaction of inadequacy brought on by intuitive recognition of inability to achieve the required rate. Has not our approach been too much one of imparting a given stock of information rather than one of developing the ability to use flows?

## Capital Productivity in a Sector with Overcapacity

Still another situation complicates the problem of achieving optimum combinations of factors. The marginal revenue product of another bale of cotton or of another bushel of wheat is probably negative in the minds of some policy-makers. To our society, these marginal values are probably well below present support prices. There is no certainty that future prices will move nearer to free market levels. Yet, forced to guess whether prices are more likely to move nearer to or away from free market prices, most agricultural economic analysts would select the former. If price projections obtained by Iowa State University researchers[7] or findings published in 1960 in Senate Document 77 are reliable, freer markets would bring lower prices. Even for farm commodities that will continue to have price supports, the outlook is generally for lower support levels.

What effect does this outlook have on lenders with their problem of pricing the additional output that will result from the use of additional capital? Whether farm management analyses are made with the use of budgeting or linear programming, the problem of pricing additional outputs during the investment period becomes more and more perplexing, particularly if estimated farm incomes are to be compared with incomes in the nonfarm sector. If declining prices are in prospect for most farm products, will not physical productivity of embodied capital have to be higher than before for given capital investments to be economical?

A similar effect results from increases in interest rates. With higher interest rates, profitability requires greater physical productivity from a capital form. For a capital good estimated to increase income by $100 a year for ten years, the present value of the income generated would be $810 if the future income is discounted at 5 percent, and only $766 if the discount rate is 6.5 percent. Thus the physical

[7] Leon E. Thompson, "Return to a free market," Iowa Farm Sci., Vol. 14, No. 10, pp. 16-18, April, 1960. Some of the work of Paulsen, Kaldor, Shepherd, Kutish, Heifner, and Futrell are summarized by Thompson.

productivity of a capital good would have to be almost 6 percent greater for profitability with an increase in discount rate from 5 to 6.5 percent.

Low-income farmers are faced with still another capital problem. A capital investment is justified if the sum of the discounted future net benefits exceeds present net cost. From the lender's viewpoint, the availability of greater future incomes out of which principal can be repaid is a necessary but not a sufficient condition for a good loan. If the increase in income is just enough for principal repayments and interest, the family must postpone any increase in its living standard in order to accumulate capital. If the capital investment does not add enough income to allow some increase in consumption, risks of defaults on payments are likely to be rather high.

An examination of the experience of the Farm Security Administration in lending to farm families in the Georgia Piedmont gives some idea of the potential for small farm operators to accumulate capital internally. When prices were adjusted to the 1948 level, the average of 76 families making enterprise adjustments increased net cash income by $500, increased cash living expenses by $300, and had $200 in additional cash income.[8] Thus 40 percent of the additional income was available for capital accumulation. Only in the case of one type of adjustment was the amount left for investment more than half of the gain in income, and this was accounted for by a small gain in net income in a form that was not available for consumption. Those families whose enterprise combinations yielded highest net incomes had the lowest average percentage of additional income available for capital accumulation. For these Georgia families, the marginal propensity to consume seemed to rise with growing incomes. This indicates an understandable reluctance on the part of low-income families to postpone the "better life" until much capital formation has taken place.

This has unusual relevance to the problem of capital formation in agriculture since the capacity of low-income farmers to accumulate capital out of net income is quite limited. Spitze indicates the importance of net farm income in capital formation within agriculture in Chapter 2. Hendrix's data indicate that low-income farmers will be able to achieve larger scales of operations (and higher incomes) only by means of capital made available from off the farms. Repayment of external capital may require lower marginal propensities to consume than can reasonably be expected.

One might speculate that an amount of external capital is needed to provide a take-off into income growth for low-income farmers. This amount may be substantial, and might enlarge the scale of operations more rapidly than managerial ability can be assisted to accommodate this growth. Yet a large lump of capital may be required in order to increase income enough to allow simultaneously a minimum increase in consumption, repayment of capital, and future capital accumulation

[8]W. E. Hendrix, Capital Accumulation by Families on Small Farms in the Piedmont, Ga. Agr. Exp. Sta. Bul. N.S. 8, Aug., 1955, pp. 20-22.

from net income. In one decade, external capital made available to farmers was only one-ninth of internal capital formation (cf. Chapter 2). In the past, capital formation from internal sources was largely confined to periods of farm price inflation, and the prospects for farm prices in the early 1960's are not favorable.

## Supply of Capital

Disregarding the question of the effectiveness of capital institutions, will enough capital be available for southern agriculture, U. S. agriculture, and particularly for the low-income group in agriculture? The answer to this question depends upon what our society elects to do about overcapacity in agriculture. At present, agriculture is characterized not only by the allocation of more human resources than is required, but also by the use of more land than is required to produce needed goods for consumption and export, and to make allowances for production fluctuations. To bring production and utilization into balance, between 50 and 100 million acres of land may need to be retired from agricultural production—the exact figure depending upon which acres are selected for retirement.

Capital needs will depend upon the land retirement method used. This subject is also discussed by Coutu and Lindsey in Chapter 21. If land is retired by government purchase at 1960 market values, then a large portion of capital will be "released." If entire units are purchased, sellers are likely to transfer their labor services to the nonfarm sector, and are almost as likely to use their liquid capital in the nonfarm sector. Even if some sellers reinvest in agriculture and continue to operate a farm, farmers who sell to them are likely to transfer their labor and capital to nonfarm activities. Some sellers must transfer completely if the quantity of human resources employed in agriculture is to be reduced. Retirement of land by purchase might lead to a need for much additional capital in agriculture, i.e., more if low-income farmers form the capital, less if farmers who are better endowed with resources form the capital. The latter will be better able to form capital out of their own income. Some erstwhile farmers might reinvest in farm land and rent it to farm operators, thus providing capital to agriculture. Unfortunately, in low-income areas, owning land solely for income is not a well-established practice and is not always profitable in comparison with alternative investments. Institutions for separation of ownership and management of resources are not well developed for agricultural resources, particularly in the South. If the government rents land redundant to agriculture, this is not likely to add to agricultural capital unless rent receivers lend to farm operators as a rentier class.

Strong production controls to reduce overproduction would probably have the effect of destroying some of the present value of agricultural capital. Funds for any additional capital formation would need to come

from outside agriculture or from current farm incomes. How rapidly this capital formation would take place would depend to a great extent upon the farm price level that resulted from these stringent production controls.

It is possible to argue that the market value of capital in agriculture is adequate for efficient production of the volume of farm products demanded by society. If this happens to be the case, then the distribution among capital forms and among regions is not optimum.

## DATA ON PRODUCTIVITY OF PRIVATE CAPITAL

Numerous data are available on resource use and productivity and on the relations between resources used and incomes. Unfortunately, neither the conceptualizations, the analytical tools, nor the interpretations have been refined enough to give us complete confidence that we can measure input productivity precisely.

Singh made a serious effort to introduce the level of management explicitly into an analysis of low incomes in a North Carolina county. For each technically feasible farm enterprise considered for the county, one to three levels of input-output relations were developed corresponding to one to three levels of management. Appropriate input-output relations were selected for each farmer, and his aggregate capacity to manage was derived from his abilities on individual enterprises. It was assumed that each farmer could make an optimum selection of enterprises and could obtain control over complementing resources available in the community and dispose profitably of owned resources not profitable for him to use. The results of these analyses show the optimum resource positions that could be reached by considering only low levels of off-farm employment, and by considering two levels of additional investment capital (Table 4.2).

In general, more capable managers tended to use more resources and to earn much larger incomes. The tendency of better managers to use more investment capital was distorted somewhat by enterprises on which nonfarm firms provided much of the capital. Farmer 6 went into commercial layers, with all of the additional capital coming from a feed dealer; other livestock enterprises often required little additional capital from the farmer.

Conversely, less capable managers tended to use fewer resources in any optimum combinations with their own human resources. For these farmers the marginal revenue productivity of additional investment capital was likely to fall more rapidly and to reach zero much sooner than for a manager assumed to be more capable. For one farmer who was a fair manager (the lowest category), making available unlimited land at the appropriate rent for his community and unlimited capital at 5 percent would not raise his net farm income enough to get him out of the low-income category. One other assumption of the Singh study should be noted. Operating capital was not treated as a limiting factor;

Table 4.2. Estimated Resource Productivity of Eleven Farmers in Macon County, North Carolina

| Farmer | Management level | Additional capital | Bottomland in acres | | | Upland in acres | | | Pasture in acres | | | MRP of capital | Income in dollars |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Available | Used | MRP | Available | Used | MRP | Available | Used | MRP | Dollar for dollar | |
| | | (Dollars) | | | (Dollars) | | | (Dollars) | | | (Dollars) | | |
| 1[a] | Good | 2500 | 14* | 14 | 33 | 8* | 5 | 0 | 22* | 10 | 0 | 0.73 | 6600 |
| | | 4900 | 14* | 1 | 0 | 8* | 0 | 0 | 22* | 9 | 0 | -- | 7900 |
| 2 | Fair | 1000 | 6 | 6 | 132 | 22* | 22 | 21 | 31* | 5 | 0 | 0.78 | 3500 |
| | | 2900 | 6 | 6 | 53 | 22* | 13 | 0 | 31* | 4 | 0 | -- | 4200 |
| 3 | Excellent | 5000 | 15 | 8 | 0 | 7 | 0 | 0 | 35* | 9 | 0 | 0.69 | 9000 |
| | | 8600 | 15 | 1 | 0 | 7 | 0 | 0 | 35* | 20 | 0 | -- | 10400 |
| 4[b] | Fair | 2600 | 25 | 25 | 55 | 28 | 28 | 29 | 43* | 2 | 0 | -- | 6700 |
| 5 | Fair | 2000 | 0 | 0 | -- | 6 | 6 | 53 | 36* | 11 | 0 | 0.05 | 2500 |
| 6 | Excellent | 0[c] | 14* | 1 | -- | 10 | 9 | -- | 0 | 0 | -- | -- | 9100 |
| 7 | Medium | 3000 | 6 | 6 | 131 | 30* | 14 | 0 | 62* | 37 | 0 | 0.35 | 3600 |
| | | 10000 | 6 | 6 | 54 | 30* | 10 | 0 | 62* | 37 | 0 | 0.11 | 5300 |
| 8 | Good | 5000 | 80* | 51 | 0 | 28* | 0 | 0 | 47* | 47 | 14 | 0.50 | 12100 |
| | | 8000 | 80* | 45 | 0 | 28* | 0 | 0 | 47* | 47 | 14 | -- | 13700 |
| 9[d] | Good | 7500 | 15 | 15 | 41 | 40 | 15 | 0 | 100* | 42 | 0 | 0.09 | 7100 |
| | | 16500 | 15 | 14 | 0 | 40 | 0 | 0 | 100* | 75 | 0 | -- | 7800 |
| 10 | Medium | 0 | 38 | 32 | 0 | 23 | 0 | 0 | 68* | 0 | 0 | -- | 5700 |
| 11 | Good | 4000 | 45* | 35 | 0 | 65* | 0 | 0 | 88* | 18 | 0 | 0.15 | 6200 |
| | | 11000 | 45* | 25 | 0 | 65* | 0 | 0 | 88* | 48 | 0 | -- | 7300 |

Source: Har Swarup Singh, Evaluation of Alternative Income Opportunities for Farm Operators in Macon County, North Carolina, unpublished Ph.D. thesis, North Carolina State College, Raleigh, N. C., 1958, pp. 161-207.

*Includes land in the community that could be rented profitable, considering the rental charges on that class of land.

[a] Hired labor available at $0.60 an hour.

[b] This farm had available the labor of 2 men.

[c] The commercial layer enterprise on this farm required no additional capital on the part of the operator. Capacity (valued at $5,000 new) for 3,500 birds was already available.

it was assumed that the optimum volume required would always be available at 5 percent. This seemed reasonable in the county, but it does help account for some of the large increases in income. More will be said below about the productivity of operating capital.

Dr. Earl O. Heady has been a pioneer in efforts to estimate resource productivities and particularly to make interregional comparisons of the productivity of capital, labor, and land. Some of the selected Heady and Shaw data seem to indicate a high level of marginal productivity of capital—considering either the direct measure or changes in the marginal revenue productivity of labor as more capital is used (Tables 4.3 and 4.4). Yet values computed from data in the study left serious questions. Is not the intercorrelation between the capital available and the quality of management a strong possibility? If this is the case, would not the apparently high marginal productivity of capital on Alabama farms be a joint return not only to more capital but to better management and more efficient labor? The magnitude of residual products that must be imputed seems to indicate that the volume of conventional inputs falls far short of explaining total productivity.

Adding the original estimate of the value of labor and the residual product assigned to labor, and dividing the result by months of labor, yields interesting results. Is it not possible that high values of labor found on the farms with low volumes of labor and high volumes of capital are really due to imputing the value of labor and management to this labor, while additional labor seldom adds any management but is truly only an increment of labor? Whatever management the well-run units with low volumes of labor have is likely to be adequate with labor added.

Further reflections on the Heady-Shaw data cause doubt about what is being measured. In a discussion of problems encountered in studying resource productivity, Dr. Glenn L. Johnson stated: "Another difficulty which may arise from the managerial process is the following: superior managers may operate on superior production functions with more resources than their less capable counterparts. Thus, managerial ability, the efficiency of the production function used, and the amount of resources employed may be highly intercorrelated. Such correlation makes it difficult to separate the productivity of resources from increases in gross income due to use of superior production functions or superior managerial ability."[9]

There is reason for concern about the degree of intercorrelation and magnitude of its effect on productivity estimates. Further doubt arises on extrapolations from a Cobb-Douglas function. The invariant exponents require that increasing or decreasing returns to scale be the rule throughout the full estimating range. Since conventional wisdom

[9]Glenn L. Johnson, "Problems in studying resource productivity and size of business arising from managerial processes," Resource Productivity, Returns to Scale, and Farm Size, Earl O. Heady, Glenn L. Johnson, and Lowell S. Hardin (eds.), Iowa State University Press, Ames, Iowa, 1956, p. 19.

Table 4.3. Estimated Resource Returns and Productivity in Selected Farming Areas of Iowa, Montana, and Alabama, 1950

| Item | Area | Low labor, level of capital: Low | Low labor, level of capital: Medium | Low labor, level of capital: High | Medium labor, level of capital: Low | Medium labor, level of capital: Medium | Medium labor, level of capital: High | High labor, level of capital: Low | High labor, level of capital: Medium | High labor, level of capital: High |
|---|---|---|---|---|---|---|---|---|---|---|
| Land investment (hundred dollars) | Montana | 224 | 631 | -- | 190 | 593 | 788 | 205 | 454 | 1108 |
| | Northern Iowa | 327 | 389 | 327 | 234 | 375 | 558 | 386 | 403 | 693 |
| | Southern Iowa | 107 | 204 | 319 | 86 | 152 | 262 | 104 | 220 | 324 |
| | Alabama | 17 | 24 | 33 | 12 | 17 | 29 | 11 | 20 | 46 |
| Machine and livestock investment (hundred dollars) | Montana | 68 | 134 | -- | 87 | 179 | 271 | 93 | 191 | 500 |
| | Northern Iowa | 65 | 95 | 139 | 65 | 105 | 145 | 89 | 104 | 211 |
| | Southern Iowa | 42 | 62 | 115 | 46 | 77 | 141 | 60 | 94 | 159 |
| | Alabama | 4 | 7 | 19 | 4 | 8 | 13 | 3 | 8 | 29 |
| Total labor (months) | Montana | 7.6 | 10.8 | -- | 18.7 | 18.0 | 18.3 | 24.8 | 27.5 | 37.6 |
| | Northern Iowa | 11.2 | 12.3 | 11.6 | 15.6 | 16.2 | 16.4 | 26.4 | 25.6 | 25.0 |
| | Southern Iowa | 11.4 | 11.6 | 11.4 | 14.3 | 14.3 | 14.6 | 20.2 | 22.2 | 24.3 |
| | Alabama | 6.0 | 7.7 | 6.9 | 12.3 | 12.9 | 13.7 | 19.2 | 23.3 | 22.4 |
| Value of all labor (hundred dollars) | Montana | 18 | 30 | -- | 38 | 40 | 41 | 46 | 61 | 87 |
| | Northern Iowa | 23 | 25 | 23 | 31 | 31 | 33 | 43 | 45 | 46 |
| | Southern Iowa | 23 | 24 | 24 | 29 | 29 | 30 | 38 | 40 | 45 |
| | Alabama | 6 | 8 | 7 | 12 | 13 | 14 | 19 | 23 | 22 |
| Value per month of all labor (dollars) | Montana | 232 | 275 | -- | 201 | 221 | 223 | 184 | 221 | 230 |
| | Northern Iowa | 206 | 203 | 195 | 197 | 189 | 203 | 162 | 177 | 186 |
| | Southern Iowa | 204 | 206 | 214 | 201 | 202 | 205 | 189 | 180 | 183 |
| | Alabama | 98 | 102 | 100 | 100 | 100 | 104 | 100 | 100 | 97 |
| Average residual product of labor (hundred dollars) | Montana | 112 | 225 | -- | 23 | 95 | 97 | 48 | 75 | 70 |
| | Northern Iowa | 40 | 51 | 66 | 26 | 37 | 36 | 18 | 29 | 33 |
| | Southern Iowa | 22 | 35 | 54 | 15 | 27 | 45 | 15 | 19 | 29 |
| | Alabama | 5 | 8 | 10 | 7 | 9 | 13 | 8 | 6 | 9 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Total return to labor (value of all labor and average residual product of labor) (hundred dollars)** | **Montana** | **130** | **255** | **--** | **61** | **135** | **138** | **94** | **126** | **157** |
| | Northern Iowa | 63 | 76 | 88 | 57 | 68 | 70 | 61 | 74 | 80 |
| | Southern Iowa | 46 | 59 | 77 | 44 | 56 | 75 | 53 | 59 | 74 |
| | Alabama | 11 | 16 | 17 | 19 | 22 | 27 | 28 | 30 | 31 |
| Total return to labor divided by total labor in months (dollars per month) | Montana | 1710 | 2357 | -- | 325 | 752 | 754 | 377 | 459 | 416 |
| | Northern Iowa | 563 | 619 | 763 | 366 | 419 | 425 | 230 | 291 | 318 |
| | Southern Iowa | 400 | 508 | 672 | 306 | 389 | 513 | 263 | 266 | 303 |
| | Alabama | 176 | 209 | 251 | 155 | 167 | 197 | 144 | 127 | 138 |
| Value of all capital services (hundred dollars) | Montana | 46 | 101 | -- | 60 | 101 | 188 | 68 | 106 | 332 |
| | Northern Iowa | 72 | 131 | 221 | 78 | 135 | 232 | 79 | 135 | 332 |
| | Southern Iowa | 44 | 81 | 146 | 45 | 84 | 160 | 49 | 84 | 196 |
| | Alabama | 6 | 11 | 24 | 6 | 11 | 27 | 7 | 12 | 41 |
| Average residual return on investment (percent) | Montana | 22.2 | 26.8 | -- | 24.5 | 18.0 | 13.9 | 21.6 | 20.7 | 12.5 |
| | Northern Iowa | 8.3 | 10.2 | 13.2 | 6.1 | 8.7 | 7.1 | 3.7 | 7.9 | 7.3 |
| | Southern Iowa | 3.8 | 8.4 | 10.5 | -2.1 | 6.1 | 10.5 | -1.9 | 3.7 | 7.6 |
| | Alabama | -9.9 | -1.9 | 3.4 | -21.8 | -7.5 | 5.7 | -35.0 | -31.2 | -0.7 |

Source: Earl O. Heady and Russell Shaw, Resource Returns and Productivity Coefficients in Selected Farming Areas of Iowa, Montana and Alabama, Iowa Agr. Exp. Sta. Bul. 425, April, 1955, Tables 30-33.

runs in terms of large increments of capital required to generate satisfactory incomes for low-income farmers in the South, there may be some question as to the usefulness of estimates outside the range of data.

A final doubt is also based on the usefulness of estimates by extrapolation. If principal reliance for higher farm incomes in the South must be on farm enlargement, then there is need to know whether optimum enterprise combinations will change as more capital is added. Unless enterprise combinations change little, there is reason to believe that the proportional and absolute inputs of land, labor, and capital would change drastically. At least, this is what Singh found in his study. The Heady-Shaw data seem to be consistent with this view, i.e., in each area, going from low labor and capital to medium labor and capital to high labor and capital added little to the marginal productivity of labor, and the increases shown may have been due in part to the characteristics of the functional form. Average returns to labor (including the residual) declined quite sharply in each of the four areas going from low, to medium, to high labor and capital.

In a recent study of the experience of families receiving loans through the Farmers Home Administration (FHA), Hendrix has published some most interesting results.[10] Assuming that productive capital is land and buildings plus working capital, in the North the average borrower originally had $6,600 in productive capital, borrowed $3,200, and increased his income by $1,300 (69 percent) and his net worth by $4,753 (100 percent). In the West, starting productive capital of $16,300 plus a loan of $4,100 led to an increase of $1,638 (63 percent) in net income and an increase of $5,570 (61 percent) in net worth. In the South, $6,500 in productive capital and a loan of $2,200 was associated with a gain of $540 (32 percent) in income and a gain of $2,100 (42 percent) in net worth. These data indicate that additional capital in association with the management ability of the particular borrowers was more productive in the North and West than in the South, even though the FHA attempts to assist borrowers in making management decisions. Comparisons of white borrowers and nonwhite borrowers in the South indicate no essential differences between them in income-earning capacities, holding working capital and off-farm employment constant. One might speculate that FHA budget limitations in relation to the number of potential borrowers in each region allowed more selectivity among nonwhite applicants in the South than among white applicants, and more selectivity among all applicants in the South than among all applicants in the North and West. Thus in the South, the average nonwhite borrower might be expected to be further above the average management ability of all nonwhite farmers than the average white borrower is above the average management ability of all white farmers. Similarly, the average borrower in the South is probably further above the average

[10]William E. Hendrix, Approaches to Income Improvement in Agriculture, USDA, ARS Prod. Res. Rpt. No. 33, Washington, D. C., Aug., 1959, pp. 6, 11, 14, and 22.

Table 4.4. Estimated Marginal Productivity of Land, Labor, and Capital Services in Selected Farming Areas of Iowa, Montana, and Alabama, 1950

| Item | Labor | Montana | | | Northern Iowa | | | Southern Iowa | | | Alabama | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Capital services | | | Capital services | | | Capital services | | | Capital services | | |
| | | Low | Medium | High | Low | Medium | High | Low | Medium | High | Low | Medium | High |
| Marginal productivity of land (in dollars per acre) | Low | 9.3 | 10.0 | 10.6 | 42.8 | 43.8 | 45.1 | 25.9 | 27.8 | 36.4 | 13.6 | 18.0 | 17.5 |
| | Medium | 9.4 | 10.2 | 10.1 | 43.5 | 45.3 | 47.4 | 28.0 | 32.2 | 34.5 | 18.0 | 20.0 | 21.8 |
| | High | 9.7 | 10.5 | 11.2 | 45.4 | 47.2 | 48.9 | 28.6 | 32.9 | 37.6 | 21.0 | 21.4 | 23.2 |
| Marginal productivity of labor (in dollars per month) | Low | 59.3 | 95.1 | 123.6 | 67.4 | 84.3 | 117.1 | 34.5 | 64.1 | 127.9 | 38.8 | 52.7 | 81.6 |
| | Medium | 32.8 | 64.1 | 82.1 | 51.7 | 62.5 | 104.0 | 30.9 | 56.1 | 81.6 | 27.4 | 39.1 | 56.6 |
| | High | 25.6 | 35.7 | 59.7 | 31.2 | 44.0 | 73.6 | 15.1 | 35.1 | 59.1 | 19.6 | 26.2 | 42.0 |
| Marginal productivity of capital (in dollar for dollar of machine-crop services) | Low | 2.0 | 2.1 | 2.2 | .6 | .6 | .6 | 1.3 | 1.5 | 1.2 | 1.0 | 0.8 | 0.8 |
| | Medium | 2.2 | 2.2 | 2.4 | .7 | .6 | .6 | 1.4 | 1.3 | 1.4 | 0.9 | 1.0 | 0.9 |
| | High | 2.2 | 2.2 | 2.4 | .6 | .6 | .7 | 1.3 | 1.5 | 1.5 | 1.4 | 1.4 | 1.1 |
| All land in acres | Low | 727 | 1493 | -- | 148 | 182 | 186 | 118 | 185 | 208 | 34 | 41 | 59 |
| | Medium | 875 | 1874 | 2210 | 123 | 189 | 264 | 137 | 175 | 213 | 27 | 44 | 53 |
| | High | 1300 | 2020 | 5286 | 164 | 212 | 296 | 154 | 230 | 210 | 28 | 47 | 80 |
| Land investment (in dollars per acre) | Low | 31 | 42 | -- | 221 | 214 | 176 | 91 | 110 | 154 | 50 | 59 | 57 |
| | Medium | 22 | 32 | 36 | 190 | 199 | 211 | 62 | 87 | 123 | 46 | 39 | 55 |
| | High | 16 | 22 | 21 | 235 | 190 | 234 | 68 | 95 | 154 | 38 | 42 | 58 |
| Marginal productivity of investment in land (in dollar for dollar of investment) | Low | .29 | .24 | -- | .19 | .20 | .26 | .28 | .25 | .24 | .27 | .30 | .31 |
| | Medium | .43 | .32 | .28 | .23 | .23 | .22 | .45 | .37 | .28 | .39 | .51 | .40 |
| | High | .61 | .48 | .53 | .19 | .25 | .21 | .42 | .35 | .24 | .55 | .51 | .40 |

Source: Heady and Shaw, *op. cit.*, Table 25.

Table 4.5. Estimated Average Improvement Expenditures and Increase in Net Income per Farm for 7-Year Improvement Programs for 56 Farms

| Item | Georgia | Indiana | Kentucky | Nebraska | Total or average |
|---|---|---|---|---|---|
| Number of cases | 13 | 14 | 18 | 11 | 56 |
| | | | (Dollars) | | |
| Improvement expenditures in 7 years | 34,948 | 17,416 | 14,792 | 10,084 | 19,207 |
| Net income at start of improvement program | 3,503 | 4,453 | 2,378 | 2,016 | 3,087 |
| Expected net income at end of improvement program | 6,231 | 7,464 | 4,789 | 3,977 | 5,633 |
| Increase in net income | 2,728 | 3,011 | 2,410 | 1,961 | 2,546 |
| | | | (Percent) | | |
| Relative increase in net income | 78 | 68 | 101 | 97 | 82 |
| Rate of annual return expected from improvements | 8 | 17 | 16 | 19 | 13 |

Source: L. E. Kreider, Farmers' Needs for Intermediate-Term Credit, Farm Credit Administration, Bul. CR-6, Oct., 1954.

management ability of all southern farmers than the average borrower in the North or West is above the average management ability of all northern or western farmers.

The results of a study conducted by Kreider show much greater income productivity for "land improvement expenditures" in Nebraska, Indiana, and Kentucky than in Georgia (Table 4.5). Southern and Hendrix found that 53 percent of the 88,060 rural family heads in northeast Texas could be considered to have "human resource limitations" that would presumably influence their economic productivity. For 15,100 full-time farm family heads, the estimate was 52 percent.[11]

Three other studies suggest somewhat unexpected productivities for operating capital. An analysis by Heady and Swanson reported that, on Iowa farms, additions to operating capital in several forms would add to net incomes, and that farmers believed this to be the case.[12] Foreman's study of owner-operated farms in the Georgia Piedmont also indicated that additional operating capital on these farms had more effect on incomes than any other step considered.[13] A report by Baker and Stoevener on the productivity of soil fertility outlays in two Illinois

[11] John H. Southern and W. E. Hendrix, Incomes of Rural Families in Northeast Texas, Tex. Agr. Exp. Sta. Bul. 940, Oct., 1959, pp. 28-29.

[12] Earl O. Heady and Earl R. Swanson, Resource Productivity in Iowa Farming, Iowa Agr. Exp. Res. Bul. 388, June, 1952, pp. 751, 756, and 767.

[13] W. J. Foreman, Resource Returns and Productivity Coefficients on Owner-Operated Farms in the Piedmont of Georgia, Ga. Agr. Exp. Sta. Tech. Bul. N.S. 9, Dec., 1956, pp. 29-38.

farm areas (one containing primarily livestock farms and the other comprised largely of crop farms) also indicated that larger outlays on fertilizer would be profitable.[14]

On small farms operated by less capable managers, capital shortages will persist for a long time. The productivity of capital on large farms with capable managers will remain high, and this group is likely to form most of the private farm capital, whether from external or from internal sources. Farming areas specializing in surplus products are likely to encounter financing difficulties because of unfavorable price prospects and associated uncertainty. Areas combining inadequate human capital formation with surplus products will have all the appearances of severe capital need, but more improvement in income can probably be achieved in the long run through greater investments in our young human resources and in the short run by the development of better institutions for human capital formation among adults.

# Discussion

SYDNEY D. STANIFORTH*

Martin very clearly indicates at the outset that his discussion is concerned with the income effects of capital on low-income farms. He concludes that a major part of the low income and low average productivity is due not to a misallocation of capital as such between size groups and between regions, but to rather serious management limitations. This is something to which we might readily agree without appreciating its implications. These implications are developed very effectively and, as such, represent a generous contribution to our attack on these capital problems.

The analysis of relative productivities of capital in different regions and in different size groups is penetrating and extremely valuable. The conclusions constitute the basis for a very important reorientation of our approach to capital allocation problems. Martin concludes that, while most studies show the marginal productivity of capital to be high in the South or other low-income areas, more capital cannot be expected to raise incomes very much in these areas because high marginal productivities depend on a higher level of management than these farms now have. Consideration of this conclusion can save us from some serious mistakes.

We can heartily agree that long-run investments designed to increase the level of management and economic responsiveness of farm people, thereby increasing the level of economic welfare, is very

[14] C. B. Baker and H. H. Stoevener, Livestock and the Productivity of Soil Fertility Outlays, Farm Mgt. Rpt. No. 189, Univ. of Ill., June 22, 1959.

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important, particularly in depressed areas of agriculture. Effective short-run methods are also to be sought. In this whole problem, however, one should follow Martin's own warning not to extrapolate expected high marginal productivities of capital beyond what we know to be forthcoming. Just because the marginal productivities of capital invested in the human factor look like they would be high in low-income areas, substantial amounts of capital might be invested there with relatively low response.

The conclusion that the already larger and more efficient farms will form most of the new capital from both internal and external sources in the years ahead has important implications. It suggests a wider separation income-wise between what is considered the commercial producing sectors and the low-income, or unemployed, sectors. By implication at least, this suggests that we can no longer attempt to treat the adjustment problem as a single problem. The low-income and aggregate production problems must be treated separately, coordinating such treatments to assure consistency but recognizing the fact that there is no single solution.