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## ON THE EFFICIENCY OF RESOURCE UTILIZATION IN SUBSISTENCE AGRICULTURE†

One way to approach the analysis of economic development is through the theory of production. The relevant question then is how to increase output per unit of input. The conceptual alternatives are (1) changing the production surface or (2) reorganizing productive inputs within a given production possibility curve. Moving the production surface means changing the parameters of the production function, usually by introducing new kinds of inputs of production. "Technological change" is a convenient label for such changes in the production function.

Given the production function, i.e., ruling aside technological change, output per unit of input may be increased by improving the efficiency with which the existing inputs are allocated. If such reshuffling of resources is possible, achieving allocative efficiency represents a relatively painless way of obtaining growth—a new version of the "up-by-the-bootstraps" approach to development. It then becomes relevant to ask how widespread is the misallocation of resources and, if it exists, what are the reasons for such misallocation. Monopolistic restrictions of entry into the field and restrictions in international trade are two of the sources of allocative inefficiency which have recently been studied and quantified.<sup>1</sup> Another source is institutional rigidities specific to less-developed countries (LDCs), e.g., irrationality, ignorance, or wastefulness. More recently, however, a number of studies have established that production in LDCs is generally efficient, given the state of technology within which it is organized (21, 10, 19, 17, 26).

The purpose of this paper is to examine the efficiency of resource utilization in a random sample of farm-firms, operating within the framework of a traditional agricultural economy. In order to do this we fit Cobb-Douglas production functions, compute the marginal product of each factor of production, and com-

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<sup>1</sup> Examples from the recent literature that quantifies the social welfare cost of monopoly are 7, 22—compare also 8; and examples of international studies that focus on restrictions to trade are 13; 11, p. 132; 24; 29. Both these types of studies lead to the conclusion that elimination of allocative inefficiency will contribute only a trivial amount to growth—usually a fraction of 1 per cent. (For a comparative presentation of the empirical results on the two types of static allocative efficiency see 15, p. 393.)

pare this with the factor's opportunity cost. A significant difference between marginal product and opportunity cost is accepted as evidence of inefficient resource utilization. On the other hand, correspondence between each factor's marginal product and its opportunity cost is accepted as evidence against the hypothesis that firms in LDCs are largely inefficient due to irrationality, ignorance, wastefulness, or other factors.

#### NATURE AND SCOPE OF THE DATA<sup>2</sup>

The data were collected by lengthy and detailed personal interviews with the heads of a random sample of agricultural households in Epirus, Greece. The sample of farm households was drawn from a sample of 110 randomly selected villages and three cities of the region. The questionnaire was designed by the author for the purpose of collecting farm management information to be used in fitting production functions, as well as collecting socioeconomic data useful in testing other ancillary economic hypotheses (e.g., migration, etc.). A total of 430 questionnaires were completed in a survey that the author conducted with 35 full-time, specially trained interviewers during the month of April 1964.

Epirus, one of the ten administrative regions of Greece, lies at the northwest tip of the country. With the possible exception of Crete and Thessaly, it is the least developed Greek region, with a per capita gross domestic product in 1962 of \$287. For comparison, the national average per capita gross domestic product is \$401, and the average for the region of Attica (mainly Athens) is \$627. Due to its seclusion, its mountainous terrain, and the lateness of its incorporation into the free Greek state, the region of Epirus displays most of the characteristics of the typical enclave economy. The main economic activity is diversified agriculture, accounting for 63 per cent of the gross domestic product of the area. It is organized in a number of small, mostly self-sufficient, owner-operated family farms.

The questionnaire information about agricultural activities, inputs and outputs, was transformed into a form suitable for production function analysis. The 1964 agricultural output of each of the farms in the sample is evaluated at local prices to give the dependent variable: gross value of agricultural production. The farm inputs are grouped into six categories: labor, land, three capital inputs (plant, equipment, and live capital), and education.

Estimating labor input in a sample of farms is a problem that has severely hampered microeconomic agricultural research, especially production function analysis. The two alternative methods usually followed in such studies are: deriving the labor input directly through the daily accounting of agricultural activities, or using a proxy for labor input, e.g., the family labor available. Neither method was satisfactory for the purposes of this study—the latter due to its crudeness, the former due to its cost and its inconsistency with the design of a one-shot survey. A new method for estimating labor input from easily accessible microeconomic farm data was devised.<sup>3</sup> It consists of applying cohort analysis on family

<sup>2</sup> For a more detailed description of the data, for methodology, as well as for further analysis of some of the results presented here, see 33. That study fits production functions for the agriculture of Epirus by concentrating on the "traditional" factors of production, labor, land, and capital, while the present article deals also with "non-traditional" factors by explicitly including education among the inputs.

<sup>3</sup> For a detailed description of the method of treating labor input see 33, ch. 6.

farm population statistics to derive total family labor supply (or *labor potential*). The family non-farm labor supply was estimated from information on each family member provided in the questionnaire. The family farm labor supply (or *labor available*) was then derived as a residual. From labor available we obtain labor input by assuming that there exists in the total farm sample a subgroup of farms that is free of underemployment and that this subgroup can be identified. For the underemployment-free subset of farms a regression was fitted between labor requirements (derived on the basis of standard technological coefficients, e.g., labor workdays employed per acre of each crop grown, workdays per head of livestock, etc.) and labor available, and this relationship was used to estimate the labor input in the set of farms that are the complement of the underemployment-free subset in the universe. Finally, labor input in the farms is expressed in homogeneous man workdays by converting work performed by women and children into man workdays equivalent (33, ch. 6; 20).

The treatment of capital inputs presents another major methodological problem. The theoretically proper variable for durable inputs is capital service flows. But measures of services are difficult to construct and are seldom available in published statistics. As a result, empirical research with capital assets has most often (and usually implicitly) involved the assumption that service flows are proportional to capital stock. A proxy for the value of capital services is thus obtained. We have shown, however, that this practice is correct only if three rather restrictive assumptions are satisfied: (1) all assets involved have the same durability, (2) they have an even age or vintage distribution, and (3) the magnitude of productive services derived from the assets does not vary with assets' age. None of these assumptions is satisfied in microeconomic agricultural research. Plant assets (houses, irrigation ditches, etc.) differ in durability; equipment assets (tractors, implements, etc.) are of different vintages; and live capital assets (animals and trees) yield streams of productive services that increase or decrease with age. The problem is solved by developing two formulas: one for the "one-hoss-shay" assets (i.e., plant and equipment assets) based on an annuity principle and original purchase price; and a second for live capital assets (i.e., animals and trees) based on the discount factor times current price less the change in price that reflects changes in service flow. Thus, the annual flow of services is derived for each plant, equipment, and live capital asset that a firm uses. Aggregation of these asset-specific service flows for each firm's assets yields the corresponding plant, equipment, and live capital inputs of production.<sup>4</sup>

Education is expressed as an index, calculated as the sum of the years of education of all farm household members in the age bracket 15 to 69, divided by the number of farm household members in this age bracket. The reason for concentrating on the education of members in the 15 to 69 age bracket is that these members are more likely either to participate directly in farm activities or to transfer their education to the household members who do the agricultural work. The interpretation, then, of the mean value of educational inputs is rather straightforward: the "average farm" had 2.24 years of education per farm member of age 15 to 69, whether this member was actually working on the farm or not.

<sup>4</sup>For a detailed description of this method of going from stock to flow capital concepts see 33, ch. 7, 8, 9. Also see 31, 32, 2.

The land input refers to cultivated area, converted into standard units by allowing for differences in productivity, especially for irrigation. The land variable also served to distinguish between small and large farms. The former are farms with a cultivated area that was less than the mean value for the whole sample, i.e., 20 stremmata (or 5 acres). The reasons for grouping in two sizes of farms are both economic and statistical. The economic logic of production suggests that the sample observations of the underlying population may not obey the same law over the entire range of the independent variables. As examination of the results will suggest, this may be likely in view of the effect that grouping has upon the input coefficients—especially labor. Statistically, by grouping the farms we hold constant the unobserved variables (e.g., entrepreneurship) that may be correlated with farm size.

#### THE PRODUCTION FUNCTION AND EFFICIENCY INDEXES

We establish the production surface within which the sample of farms operates by estimating an unrestricted Cobb-Douglas production function. The function, in logarithmic form, is written

$$y = \sum \beta_i x_i + \varepsilon \quad (1)$$

where  $y = \log$  of output;  $x_i = \log$  of input  $i$ ;  $\varepsilon =$  the disturbance; and the  $\beta_i$  are the production coefficients.<sup>5</sup>

The main results of fitting equation (1) to the data from the sample of Epirus farms are presented in Table 1. Four regressions are reported. Regression R2 is fitted for the total sample of 430 farms with the complete set of six independent variables. For purposes of comparison of the effects of including education in the function, regression R1 is reported with only five independent variables. Regressions R2.1 and R2.2 distinguish between small and large farms, respectively.

All regressions are significant at the 1 per cent level. The size of the coefficients of multiple determination suggests that a major part of the interfarm variation in output is explained by the observed inputs—e.g., 79 per cent for regression R2. Most of the input coefficients are significant at the 5 per cent level, using a two-tail test. Exceptions are the coefficients of land, plant, equipment, and education for the group of large farms (regression R2.2) and the land coefficient for the group of small farms (regression R2.1). The distinction, therefore, in farm groups based on land size should be considered as only indicative.

Since the sum of production coefficients is not significantly different from one, the results suggest constant returns to scale. This finding is consistent with other comparable studies of agriculture from all over the world (9, ch. 17; 28, Table IV). Furthermore, this is what one would have expected *a priori* if we assume a closed set of factors of production and full divisibility of all factors. The former assumption is violated by the omission of management. If management varies less than proportionately with changes in the other factors over the range of the sample observations, omission of management leads to underestimation of returns to scale (5). By including the education variable, however, the sum of the coefficients

<sup>5</sup> On the statistical specification of the estimating equation see 33, ch. 10. For the complete specification of the residual term see 3, 4.

TABLE 1.—PRODUCTION COEFFICIENTS AND RELATED PRODUCTION FUNCTION STATISTICS FOR FITTED REGRESSIONS†

Re-gres-sion num-ber	Variable							Sum of co-efficients	R <sup>2</sup>	Farm class
	Y Output	X <sub>1</sub> Labor	X <sub>2</sub> Land	X <sub>3</sub> Plant	X <sub>4</sub> Equip-ment	X <sub>5</sub> Live capital	X <sub>6</sub> Edu-cation			
COEFFICIENTS <sup>a</sup>										
R1	...	.442	.092	.048	.041	.259	...	.882	.626	All
	(.177)	(.058)	(.042)	(.012)	(.015)	(.034)	...			
R2	...	.441	.093	.046	.044	.247	.138	1.009	.794	All
	(.177)	(.057)	(.042)	(.012)	(.015)	(.035)	(.067)			
R2.1	...	.425	.066*	.056	.063	.223	.143	.976	.714	Small
	(.178)	(.067)	(.056)	(.015)	(.018)	(.043)	(.073)			
R2.2	...	.550	-.109*	.024*	.006*	.261	.086*	.818	.641	Large
	(.171)	(.122)	(.121)	(.022)	(.025)	(.061)	(.171)			
SAMPLE MEANS (Geometric) <sup>b</sup>										
R1	9,817	176	12	366	335	4,558	...			
	(2.53)	(2.19)	(2.67)	(10.43)	(8.06)	(3.14)	...			
R2	9,817	176	12	366	335	4,558	2.24			
	(2.53)	(2.19)	(2.67)	(10.43)	(8.06)	(3.14)	(1.52)			
R2.1	6,884	128	7	258	214	3,027	2.14			
	(2.68)	(1.98)	(2.07)	(10.03)	(7.49)	(2.77)	(1.59)			
R2.2	20,320	338	35	744	838	10,543	2.41			
	(1.97)	(1.68)	(1.60)	(9.66)	(6.94)	(2.46)	(1.33)			
MARGINAL PRODUCTS <sup>c</sup>										
R1	...	24.64	75.51	1.29	1.21	.56	...			
R2	...	24.41	75.94	1.23	1.29	.53	606.40			
R2.1	...	23.01	...	1.52	1.90	.54	460.03			
R2.2	...	32.59	...	...	...	.52	...			

† The production function used, as described in the text, is of the Cobb-Douglas logarithmic form. The primary data used, also described above, are annual figures per farm. Of the 430 farms surveyed, 289 were classed as small, 141 as large. One U.S. dollar is equal to 30 drachmas (drs.).

Y is the gross value of agricultural production in drachmas.

X<sub>1</sub> is man-days worked.

X<sub>2</sub> is the number of stremmata cultivated. One stremma equals .247 acres.

X<sub>3</sub> is the value of current services of plant plus operating expenses for plant, in drachmas.

X<sub>4</sub> is the value of current services of equipment plus operating expenses for equipment, in drachmas.

X<sub>5</sub> is the value of current services of live capital plus operating expenses for live capital, in drachmas.

X<sub>6</sub> is the total years of education of farm household members age 15-69, divided by the number of farm household members age 15-69.

<sup>a</sup> Non-starred coefficients are significantly different from zero at a probability level of ≤ 5 per cent. Starred coefficients (\*) are not statistically significant at a probability level of ≤ 5 per cent. Numbers in parentheses are the calculated standard errors of the respective coefficients.

<sup>b</sup> Numbers in parentheses are the standard deviations of the means, expressed in natural logs.

<sup>c</sup> Estimated at the mean values of input and output; not computed for the statistically nonsignificant coefficients, see note a. Expressed in the following dimensions:

Labor in drs. per workday

Land in drs. per stremma

Plant in drs. per dr.

Equipment in drs. per dr.

Live capital in drs. per dr.

Education in drs. per year

Change in household education.

becomes equal to one. With the same *a priori* reasoning as above, one might conclude that education is a good proxy for entrepreneurship.

The input coefficients are interpreted as elasticities of production. Labor has the highest coefficient, .441 (in R2). Next in importance are the coefficients of live capital, .247, and education, .138 (both in R2). The shares of the factors of production are consistent with *a priori* expectations. One who is acquainted with the

labor-intensive technology of Greek agriculture is not surprised to find that the share of labor is just under one-half of the total output. One might venture the guess that the relative share of education is rather small, compared to similar studies for the U.S. (6, Table 2). It turns out, however, that the absolute effect of education is very significant. This will become clear from the discussion of marginal productivities below.

The marginal product of a factor can be computed as the product of the factor's elasticity times its average product. Given the relevant elasticities, marginal productivities can be computed at any point on the production function. It is convenient, however, to present the discussion in terms of the "average farm," i.e., at the geometric means of output and inputs. And estimation at the geometric means is the most relevant in the context of a Cobb-Douglas function (9, ch. 17).

The geometric means of the variables and the marginal productivities of the inputs are also presented in Table 1. The dimensions of these values are given in the notes accompanying the table. We proceed here to comment in detail on the estimated marginal productivity for each factor of production and to calculate, where feasible, the corresponding efficiency index.

#### LABOR

The marginal product of labor, computed at the geometric mean of input and output, is 24.41 drachmas (with a standard error of 3.22 drs.), or \$.81,<sup>6</sup> per man workday ( $R_2$ ). It is slightly lower for small farms (23.01 drs.) and considerably higher for large farms (32.59 drs.). This is as one might have expected; besides being more land intensive (by definition), large farms also use higher quantities of other non-labor inputs of production as compared to small farms.

How does the marginal product of labor compare to the factor opportunity cost? The weighted average wage rate per homogeneous man workday reported in the questionnaire for hired-in labor is 52.25 drs. (the standard error is 14.46 drs.), or \$1.75. One might reject the null hypothesis that the frequency distribution of the marginal productivities and the frequency distribution of the wage rates have the same means. However, it is more relevant to compare the marginal product of labor to the opportunity cost, and we can obtain an approximation of the opportunity cost of labor in our sample of farms.

The demand for wage labor in the agriculture of Epirus is only seasonal, concentrated mainly in the fall and spring seasons of peak agricultural activities. Agricultural labor "shortage" is prevalent during these seasons (20, especially Table 5; 30). On the other hand, due to the low degree of industrialization, in the off-peak seasons of winter and summer there is no alternative nonagricultural employment offered and seasonal "surplus" labor is observed. During these seasons the opportunity cost of family labor may be considered as zero. By weighting the seasonal wage rate of 52.25 drs. by 56 per cent, which is the proportion of the total agricultural work in Greece that is performed in the two peak seasons (20, year 1960), we arrive at an approximation of the true year-round opportunity cost of labor of 29 drs., or \$.97. If this is true, the marginal productivity of labor, as computed from  $R_2$  (also from  $R_1$ ,  $R_{2.1}$ , and *a fortiori* from  $R_{2.2}$ ), is not sig-

<sup>6</sup> One dollar is equal to 30 drachmas.

nificantly lower than the true opportunity cost of labor. Actually, the ratio of marginal product of labor to opportunity cost is .84—very close to the efficiency index of 1.00 that would signify perfect resource allocation.

#### LAND

The marginal product of land, computed at the geometric mean of input and output, is 75.94 drs., or \$2.50, per cultivated standard (i.e., unirrigated) stremma per year for R2. Data on the annual rent per stremma of unirrigated land in Epirus are not easily available. Nevertheless, general agronomists' information<sup>7</sup> indicates that a reasonable estimate of the market opportunity cost of cultivated land in the region lies between 80 and 100 drs. per stremma—which is reputedly the modal value of the annual rental of land. If this is correct, the difference between the marginal product of land and its opportunity cost appears negligible.

#### CAPITAL

Interpretation of the marginal product of capital is more difficult and computation of an efficiency index is impossible. The marginal productivity of capital is a pure number, since it is expressed in terms of output drachmas per input drachma. Our estimated marginal product of capital is closer to Scitovsky's *profit margin* (23), which expresses the return to a machine per year over the lifetime of the machine, rather than to the *internal rate of return*, which shows how much a machine will be yielding per year to perpetuity. As a result, we cannot directly compare this profit margin to a rate of interest in order to compute an efficiency index. However, for inputs that are measured in units of drachmas per drachma per year, marginal productivity coefficients of the order to 1.2 are usually considered reasonable in the literature (6, p. 968). The marginal productivities of plant and equipment are thus deemed quite satisfactory. The estimated marginal product of live capital is invariably low (about .50 drs.). The explanation of this surprising finding may lie in the fact that live capital input, as measured here, is a scalar measure of a vector of heterogeneous components (e.g., chickens, cows, olive trees, etc.) and may be expected to have greatly varying productivities. In such a case, one may have expected a downward bias in the elasticity, which, in turn, may explain the low estimated marginal productivity.

#### EDUCATION

The marginal product of education, computed at the mean of 2.24 years of education per farm household member of age 15 to 69, is 606 drs., or \$20.20. It becomes evident from the mean value that this is primarily elementary education. The number of farm household members with high school education was insignificant and any formal technical education was nonexistent. Had it been possible to estimate the cost of providing one additional year of grade-school education to 3.00 persons—the average number of farm household members age 15 to 69 in the sample—we could have obtained some very meaningful comparisons of the costs and benefits of education in Epirus. This would have led to computing

<sup>7</sup> Sources are the agronomists consulting for the study at the Center of Planning and Economic Research, Athens.



a social rate of return to education, through which we could have directly approached the question of overinvestment or underinvestment in the education of the farm population. Since we lack data for such comparisons, we can proceed from here only by compounding assumptions on guesswork.

Agricultural activities, as a result of one year's education for each member of a household, provide a real net<sup>8</sup> earnings stream of  $Y_0, Y_1, \dots, Y_n$  per year for the  $n$  years of the period. The alternative stream of earnings that the household would have received without education in the same period is  $X_0, X_1, \dots, X_n$ . The marginal product of education is actually defined as the difference between these two alternative income streams.

$$K_j = Y_j - X_j \quad (2)$$

The capitalized value of one year's education per member of a household can then be expressed as

$$V(K) = \sum_1^n \frac{k_j}{(1+r)^j} \quad (3)$$

where  $r$  is the relevant rate of discount,  $k_j$  is the marginal product of one year's education per household member in year  $j$ , and  $n$  is the total number of years for which this education will retain its productive value.

Assume that the productive value of the resources imbedded by education in the "average" household member will last for as long as this member remains in the labor force—say, to age 69. Furthermore, assume that the value of education received does not depreciate with age (a reasonable assumption) nor does it appreciate with age (a rather extreme assumption in view of the literature on learning curves and on learning by doing). Also, assume a static framework within which the marginal product of one year's "average" education will remain constant at 606 drs. for the rest of the productive life of the "average" household member. Under these assumptions equation (3) can be simplified to

$$V(K) = \frac{k}{r} [1 - (1+r)^{-n}] \quad (4)$$

where  $k$  is the constant annual marginal product of one year's education per household member,  $r$  is the relevant rate of discount,  $n$  is the number of productive years remaining in each member's life until he reaches age 69, and  $(1+r)^{-n}$  is a correction for the finiteness of life that tends toward zero as the length of the working life increases (*I*, p. 32).

The value of equation (4) was computed from annuity tables at 5 per cent rate of discount and  $n = 1$  to 54 so that it covers all age brackets from 15 to 69. The results are weighted by the number of household members in each age bracket. Thus, the weighted capital value of one year of education per household member was estimated at 8,437 drs., or \$281.20.<sup>9</sup> Since the average household has 2.24 years of education per member, the total capital investment in education is equal to

<sup>8</sup> That is, after deduction of the household's expenses for education.

<sup>9</sup> Since this value was computed from the marginal product of education, we may consider it as the demand price for one year of education per household member.

18,900 drs. per household, or \$630.<sup>10</sup> This is a surprising finding. The capitalized value of education for the average household is higher than the capital value of all its other three forms of capital, which has been estimated at an average of 17,393 drs., 3,341 drs., and 233 drs., for live capital, plant, and equipment assets, respectively. No matter how we approach education, whether from the point of view of capital investment, from the side of its marginal product, or from the aspect of its share in the total output, it seems that the meager amount of 2.24 years of education per household member is an important factor of production in our sample of Epirus farms. This may well be another shred of evidence pointing to the fact that the greatest assets in Greek agriculture are the farmers themselves.

#### CONCLUDING REMARKS

This paper has fitted production functions for a random sample of family farms in traditional Greek agriculture. By computing the marginal product of each input of production for the "average" farm and comparing it to the factor's opportunity cost, we have evaluated intrafirm allocative efficiency. For labor and land, the two inputs of production for which an "efficiency index" could be readily estimated, the value of this index was close to one. Although an "efficiency index" could not be constructed for capital inputs and education, the estimated marginal products of these resources are consistent with allocative efficiency.

T. W. Schultz, in his refreshing study on traditional agriculture, has aptly juxtaposed two hypotheses: poor *but* efficient vs. poor *and* inefficient (21, especially ch. 3). The poor but efficient hypothesis is confirmed by this study of the traditional agriculture of Epirus. The implication of this result is that poverty in Epirus is not due to the misallocation of the existing agricultural resources. Mere reshuffling of factors of production could not be expected to contribute significantly to economic development. Poverty is more likely due to the low stock of factors of production. By increasing the quantities of complementary factors of production (plant, equipment, improved seeds, knowledge, etc.) one may expect that the production possibility curve will be pushed outward and a new equilibrium will be obtained at higher levels of marginal productivity for all factors.

A second point made by Schultz is that "the economic acumen of people in poor agricultural communities is generally maligned" (21, p. 36). The alleged widespread economic irrationality of people in poor countries has been suggested as grounds for the inapplicability of economic theory in LDCs (25). The evidence presented here, of allocative efficiency in Greek agriculture, tends to support the relevance of economic theory in economic development.<sup>11</sup>

One last question remains. We found that the sample of Epirus farms studied is efficient "on the average." What does this imply as far as the efficiency of individual farms goes?<sup>12</sup> If all farms had also been individually efficient, we would have expected to observe that they have the same size, identical input-out ratios,

<sup>10</sup> I assume here that the marginal value of one year of education per household member is equal to the average value. If the marginal product of an additional year of education is actually declining, the total capital investment in education is underestimated. The opposite is the case if the marginal product of one year of education is increasing, at least in the early stages of the educational process. Then the assumption used overestimates the total capital investment in education.

<sup>11</sup> On this point see also 14.

<sup>12</sup> The question of the efficiency of the individual farm has been examined in 28a.

and the same input combinations. Indeed, they would all have been on the same point in the seven-dimensional space of inputs and outputs and there would have been no regression.

The usual interpretation of the production function is that, although individual firms attempt to maximize profits, they are not uniformly successful in doing so due to differences in their managerial abilities. This is one explanation of the residuals around the regression line (16; also 18, ch. 3). Our test is mainly a test of whether individual firms *attempt* to be efficient, i.e., to maximize profits. Having found that "on the average" they *succeed* in being efficient, we may assign a high probability value to the extent that individually they *attempt* to be efficient. If we had a target and a number of shooters, the closer the distribution of the shots to the bull's eye (*stochos*) the higher the probability that the individual shooters were aiming *at* the target. This is the usual interpretation of a stochastic relationship (27, p. 4).

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