CENTER OF ECONOMIC RESEARCH

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Printed in Greece
in 12 on 8 point Baskerville type
by F. Constantinides & C. Mihalas.

THE CENTER OF ECONOMIC RESEARCH

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The final aim is eminently practical: to help in creating a better life for the Greek people.

GEORGE COUTSOUMARIS, Director

THE ELASTICITY OF THE LABOR SUPPLY CURVE: A THEORY AND AN EVALUATION FOR GREEK AGRICULTURE *

I

THE THEORY

1. INTRODUCTION

Underemployment, surplus labor, and disguised unemployment are concepts frequently occurring in post-war economic literature, particularly that dealing with agriculture in less developed countries. These terms are commonly understood as the gap between some norm ("full employment") and the amount of time actually worked in a year. However, both the norm and the time

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* I am greatly indebted to Professor Robert E. Baldwin of UCLA for the ideas and challenge he contributed to the shaping of this article. Professors G. C. Archibald, Adam A. Pepelasis, and George Coutsoumaris and Mr. Leonard Miller read earlier drafts and contributed valuable comments, while Mr. K. Prodromidis helped with the calculations. Research on this article was partly supported by the Research Committee of the Graduate School of the University of Wisconsin. For both ideas and support the author is thankful — and gladly accepts the thankless task of bearing sole responsibility for the remaining errors.

worked are notions which conceal treacherous problems and ambiguities.

Thus, the figure for full employment is determined by institutional and physical factors which vary in different periods and countries. For example, vacation time in the U.S. is not only longer now than it was 50 years ago but also differs from what is current in, say, Mexico.

Similarly, the amount of time worked in a year depends upon the remuneration for that work. One example would be the case of farmers who choose to stop work before reaching the conventional norm because the marginal product of their labor has fallen below a certain level; they prefer to be idle rather than push their marginal product even lower. Contrariwise, should this product rise—due, for example, to the introduction of better techniques or more capital *or the withdrawal of labor*—the farmers might very well choose to work up to or even beyond the norm. Such an exertion, we may assume, is probable only within a certain range of the marginal product. Increasing this product beyond a certain point may cause little or no further increase in the quantity of labor supplied. In other words, a certain elasticity may prevail up to a point on the supply curve of labor; past this point the curve may become highly inelastic—or even backward sloping.

In discussions of surplus labor in underdeveloped countries, it is regularly assumed that idle workers could be removed from the farms without a decrease in agricultural output. However, considering this question in terms of marginal productivity elasticity of labor, we see at once that a decrease in total output must follow when the elasticity of the labor supply curve has become zero or negative. Furthermore, we shall show in Part I, by the use of a graphical model, that even when the curve is elastic, withdrawing idle workers always results in decreased output if leisure is not an inferior good; this decrease is significant, however, only when the elasticity is less than one.

In Part II we shall use data from 1962 to determine empirically whether, given the present level of the marginal product of Greek agriculture, we operate on the elastic or inelastic part of the labor supply curve. The marginal productivity elasticity of the supply curve of labor will be deduced from the size of the gap between the amount of total labor available at the full employment norm and the amount of total labor required to maintain present output. Thus, should we find lack of excess labor (the total amount of labor required is equal to the total amount of labor available) we would expect the supply curve of labor to be rather inelastic. Farmers who have already reached the full employment norm are least prone to increase the quantity of labor they supply in response to an increase in the marginal productivity of labor. Contrariwise, in so far as the time worked falls short of the norm, we surmise an elasticity of the labor supply curve greater than zero. If farmers have not reached the institutional full employment level, we would expect that a certain increase in their marginal product would provide an incentive for longer work. More generally, we maintain that the elasticity of the labor supply curve varies in direct proportion to the gap between the norm and the actual time worked. This is the basic postulate that links the theoretical and the empirical part of this paper.

2. THE MODEL

The subsequent discussion assumes the minimum possible release of the *ceteris paribus* condition while part of the labor force is withdrawn from agriculture. The labor force may be reorganized or may work longer hours, but techniques, crop-mix and the quantities of the other factors of production must remain constant. Could the total output be maintained under such assumptions despite the withdrawal of a part of the labor force? It will be shown that this could happen only under the implausible assumption that leisure is an inferior good.

Nor are we constructing a straw man by formulating the problem in this way, for the proliferating literature on disguised unemployment makes exactly these assumptions to reach the conclusion that labor could be withdrawn while output was maintained [1]. This idea has fascinated some economists, who thought that underdeveloped countries could thus pull themselves up by their own bootstraps. Were it so, development could have been a relatively easy matter of effectively utilizing the labor force that is unemployed in disguise, without a substantial sacrifice of current consumption and without resorting to foreign capital [2].

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1. For examples see: Ragnar Nurkse, *Problems of Capital Formation in Underdeveloped Countries,* (Oxford: Basil Blackwell, 1955). pp. 32 - 33; Paul N. Rosenstein-Rodan, «Disguised Unemployment and Underemployment in Agriculture», *Monthly Bulletin of Agricultural Economics and Statistics,* Rome, FAO, Vol. VI, Nos. 7 and 8, (July - August 1957), p. 1; Jacob Viner, «Some Reflections on the Concept of Disguised Unemployment», *The Indian Journal of Economics,* Vol. 38, No. 148, (July 1957), p. 17; Harvey Leibenstein, *Economic Backwardness and Economic Growth,* (New York: John Wiley and Sons, Inc, 1957), pp. 59 - 60; United Nations, Department of Economic Affairs, *Measures for the Economic Development of Underdeveloped Countries,* (New York, 1951), p.7. Cf. also Pan A Yotopoulos, «The Elusive Test of Disguised Unemployment: John Lossing Buck's Data», *The Indian Journal of Economics,* Vol. XLII, No. 164, (July 1961), pp. 27 - 28.

2. The best formulation of this thinking may be found in Ragnar Nurkse, *op. cit.*, pp. 32 - 56; and W. Arthur Lewis, «Economic Development with Unlimited Supplies of Labor», *The Manchester School of Economics and Social Studies,* Vol. XXII, No. 2 (May 1954), pp. 158 - 160.

Obviously there is no case of a "widow's cruise" when some inputs are withdrawn from agriculture if the supply curve of agricultural labor is backward bending. We will proceed to show that even under the "normal" assumptions about tha labor supply curve there is no "widow's cruise".

Let us consider the case of a farm worked by two men[3]. They have to make some arrangement about the division of both inputs and outputs. We will assume first, that they agree to work the same number of hours and to divide the output equally. The burden of the argument is unchanged if they split inputs and outputs in some other proportion, so long as that proportion is fixed. The case in which one man may vary his input independently of the other is discussed below.

The global production frontier, as a function of income-leisure, is represented by QM in Figure I. We may now trace out the opportunity frontier for each individual on the "equal shares" assumption. Suppose that the joint input is QB and the output BC. We mark $QA = \frac{1}{2}\ QB$ and we erect the perpendicular to A. C′, chosen so that $AC' = \frac{1}{2}\ BC$, is then a point on the frontier

3. There is no loss of generality, but great gain in simplicity of exposition, in limiting the discussion to two individuals.

for each individual. The locus of all such points QC′M′ represents the "equal shares" opportunity frontier. In carrying out this operation we have actually transposed the income axis to O′, and M′ corresponds to M in the same way as C′ to

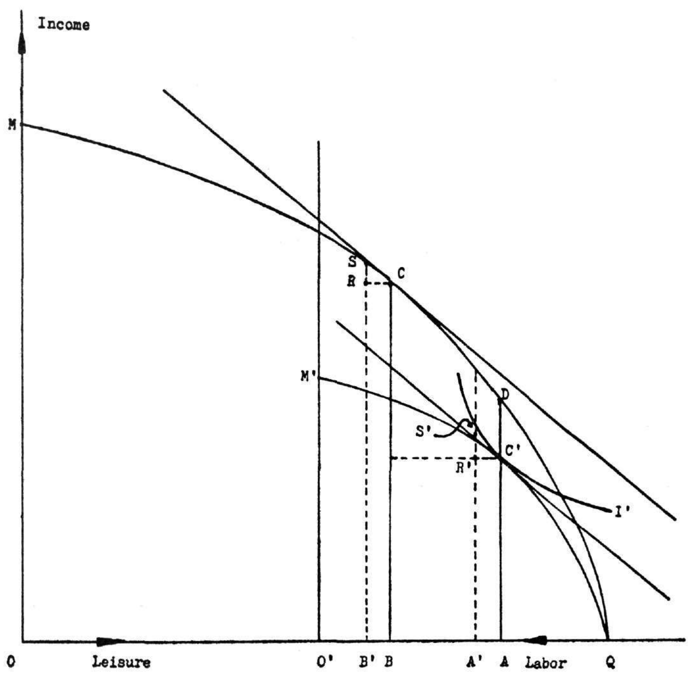

FIGURE I

C. Notice particularly that the slopes of the two frontiers at corresponding points are equal, at C and C′, at M and M′, etc.

We may now make either of two assumptions about tastes, that they are identical or that they are not. In the former case, there is no community decision problem. Each individual chooses the same point on QM′, say C′, and the joint output is at C. In the second case, there is a bilateral monopoly problem which may be decided by bargaining, bluff, penny tossing, or arbitration. This is a notoriously tiresome problem, and we shall therefore assume identical tastes and thus tangency of QM′ with both indifference maps at C′.

Now assume that one individual leaves the farm. The opportunity frontier for the remaining individual becomes the (global) production frontier, QM, instead of the "equal-shares" frontier QM′.

If the labor supply curve is perfectly inelastic, the remaining individual continues to work QA hours, and his new indifference map will have a tangency with the production frontier ar D. AD describes a level of income that is more than one-half the level BC income that the two workers achieved together. This result is explained by the increase in the marginal productivity of labor of the remaining individual after one person was removed from the farm. An indifference map and production frontier tangency to the right of D signifies that the individual is operating on the backward sloping, negatively elastic part of his supply curve of labor. With an increase in the price of labor he supplies less of it.

More interesting is the case when the supply curve of labor is elastic. The problem is to determine how much the remaining individual will choose to increase his hours of work, or rather, to see if any limitations can be put on the range of QM within which he may consistently choose.

Notice first that leisure has become more expensive: the frontier through D is steeper than the frontier through C′. Thus the substitution effect operates in favor of doing more work. If neither leisure nor income is inferior, however, the income effect operates in favor of doing less work, so that we appear to have the usual qualitative impasse. It turns out that in fact we can go further, making use of the fact that the slope at C is the same as that at C′. Thus suppose that the individual were observed to go to C. Since prices are the same at C′ and C, this would be a purely income-induced move: C′ and C would be points on an expansion, or income-consumption path, and leisure would obviously be an inferior good. *Hence, so long as we assume that leisure is a normal good, the individual cannot move to the left of C: output must decline*[4].

For the sake of completeness and before we

4. We may express this in a slightly different way. There is no substitution effect in going from C′ to C, although there is in going to any point short of C. Thus so long as a normal income effect is pulling the individual back to the right of D, the substitution effect cannot take him to the left of C.

draw conclusions from our analysis we may see how the argument stands if we alter the contractual arrangements between the partners. Suppose, first, that one individual settles for an input of QA and income of AC′, while the other is free to vary his input, receiving the whole of any output in excess of BC. His frontier now lies above QM′ to the left of C′. The construction of the corresponding points is as follows. Construct two perpendiculars to A′ and B′, each the same distance to the left of A and B respectively. Construct the right angled triangle SRC and transfer it to S′R′C′. S′ is a point on the individual's frontier under the new contract. (Note that it lies above QM′ *and* the price line through C′). But S and S′ are corresponding points in the same way that C and C′ are. If the individual chooses S′, the joint output will be at S. If the other individual leaves, the remaining man will not go to the left of S, by the argument employed above, (unless leisure is an inferior good) and output will fall.

A second possible arrangement is that the one individual is free to vary his input, the input of the other individual being fixed at QA, but that he continues to get half the total output whatever it may be. Now the individual's frontier passes through a point midway between R′ and S′; but we may obtain corresponding points and argue exactly as before.

The conclusion of our graphical analysis is that output is bound to fall following a withdrawal of some workers from the farms, unless we assume that leisure is an inferior good. It is, of course, obvious that if the labor supply is inelastic or backward bending the decrease will be drastic — from BC to AD or even less. For an elastic supply the decline in output may be slight — possibly just below BC. *What is most important, however, is that even on the most "normal" assumptions output must fall.*

If, of course, the condition *ceteris paribus* is released by a change in techniques, crop-mix or the quantities of other factors of production, the production possibility curve will shift to the right. Also, if the type of "wage rate-efficiency" phenomenon postulated by Harvey Leibenstein [5] occurred, with withdrawal of labor resulting in the remaining workers producing more "units of work" per hour, then our results would be

5. Harvey Leibenstein, «The Theory of Underemployment in Backward Economies», *Journal of Political Economy*, Vol. LXV, No. 2 (April 1957), pp. 91-103; the same, «Underemployment in Backward Economies, Some Additional Notes», *ibid.* Vol. LXVI No. 3, (June 1958), pp. 256-58; Hannan Ezekiel, «An Application of Leibenstein's Theory of Underemployment», *Journal of Political Economy*, Vol LXVIII, No. 5, (October 1960), pp. 511-517; Dipak Mazumdar, «The Marginal Productivity Theory of Wages and Disguised Unemployment», *The Review of Economic Studies*, Vol. XXVI, (3), No. 71, (June 1959), pp. 190-197; Pan A Yotopoulos, «The Wage-Productivity Theory of Underemployment: A Refinement», *The Review of Economic Studies*, (Jannary 1965), forthcoming.

altered. Under such conditions output might be maintained or even increased.

We are now in a position to evaluate the feasibility of withdrawing rural labor as a means to increase the relative importance of the urban sector in developing economies, while there is still a sufficient output from agriculture to maintain the non-farm workers and, of course, those remaining in the farms. This goal can be achieved easily only when the supply curve of agricultural labor is highly elastic within the relevant range. Only under these conditions can we say that a potential reserve of labor exists to be tapped as the marginal product of labor rises.

II

THE EMPIRICAL EVALUATION

1. INTRODUCTION

We shall determine the elasticity of the labor supply curve by estimating the extent of excess labor. We define *excess labor* as the difference between the amount of labor to be had in agriculture evaluated at its upper limit (*labor available*) and the amount of labor actually employed in agricultural activities (*labor required*). If we find a lack of excess labor in agriculture—i.e. the labor required is equal to or more than the labor available—we then conclude that the supply of labor in agriculture is perfectly inelastic; any decrease in the quantity of labor employed in the farms would lead to a drastic decrease in total output.

Contrariwise, the existence of excess labor implies an elasticity greater than zero in the relevant range of the labor supply curve. If labor working on the farms is withdrawn from agriculture, the marginal productivity of the remaining labor force will increase. This effect will be reinforced by the increase in the quantity of labor supplied per farm worker, and the net decrease in total output may be only slight.

Both labor available and labor required are constructs which assume operational validity by the use of certain empirical definitions. For the former, the norm is the upper limit of the amount of labor supplied per year by adult male agricultural workers. Taking into consideration the institutional and climatic framework of Greece, we define this upper limit as 260 man-productive days. By applying relevant conversion coefficients we render the amount of labor supplied by women and children commensurate to man-productive days; the resulting adjusted sum of *Man Productive Days* then gives the total labor available in agriculture in one year.

With regard to labor required, there are three ways of finding the definition of the norm:[6] (1) How much labor is actually employed to produce a given output? (2) What is the necessary density of population for a given type of cultivation? (An alternative form of this concept is the amount of labor necessary to cultivate an acre of land for a given crop or to raise a head of livestock, with the existing capital and technological constraints). (3) How much labor is required under a given type of cultivation to provide a person with a standard income?

6. P.N. Rosenstein-Rodan, *op. cit.*, p. 2.

In this study, labor required represents the amount of labor actually put into agricultural activities and is thus a combination of the first and second variants. To determine this figure we employed "labor intensity coefficients" (in man-productive days) used per unit of land, livestock or output in order to produce each of the actual products grown in a year. These coefficients were established by inquiries into the different types of cultivation, sizes and types of farm land, degrees of mechanization and other characteristics presently prevailing in Greek agriculture. Aggregation of the labor requirements for the total area cultivated, the size of the stock, or the size of the year's crop thus yields the total labor required in agriculture.

In our definition of excess labor we have not yet considered the time-unit. It is possible that the labor available may exceed the labor required for one month, while the situation is reversed when the whole year is taken into account. It is important, therefore, to make explicit the time period we adopt for the evaluation of excess labor.

We will actually describe excess labor in three ways. First, the difference between labor available and labor required can be expressed in terms of a whole year (see section 3). This *average annual excess labor* is a misleading measurement deprived of any practical significance from the point of view of policy recommendations. It overlooks the seasonal characteristics of agricultural operations by leveling off the seasonal employment peaks and troughs.

Second, the *seasonal excess labor* is derived by distributing the labor availabilities and labor requirements over the seasons of the year (see section 4). Seasonal excess labor does not participate in the productive operations only for a part of the year and can consequently be dispensed with intermittently.[7]

The third measurement of excess labor is best adapted to the question we are studying—that of permanently withdrawing some labor force from the fields (see section 5). We define *minimum annual excess labor* as the difference between the peak season actual employment (labor required) and the full employment level (labor available). We will use the estimate of the minimum annual excess labor in order to

7. Agriculture is an industry with a high seasonal component of underemployment because of the pronounced crop-cycle. However, it should be made clear that from the standpoint of the community's agricultural production as a whole, what determines the degree of seasonal underemployment is not so much the high or low seasonality of all crops under cultivation. It may be that several crops with highly seasonal labor requirements so dovetail together that the resulting aggregate actual labor employment presents a smooth distribution over the year with a minimum seasonal component of underemployment.

determine the elasticity of the supply curve of labor.

2. LABOR AVAILABLE IN AGRICULTURE

Arriving at an estimate of the amount of agricultural labor available by using census of population data is a difficult and somewhat hazardous task. The size of the labor force committed to agriculture is seldom entirely evident, and even less clear is the degree to which different members of the farm household participate in agricultural work. The length of the work-year has to be defined, and the labor of different age and sex groups has to be converted into a standard equivalent. In order to find from the raw data given by the Census an estimate of the actual labor available, we worked with the following assumptions and definitions:

A. *Agricultural Labor Potential.* We define agricultural labor potential as the sum total of homogeneous labor units for different age and sex groups committed full-time to farming. We thus exclude persons physically incapable of working, attending shool, or principally engaged in household activities and handicrafts. For people with dual employment, our definition includes only that portion of their activities which is devoted to agriculture.

Because of limitations of statistical data we constructed our measurement of labor available by starting with the 1961 census of population "economically active" in agriculture. The term "economically active" included all persons over 10 years of age (excluding these serving military duty or prison terms) who were engaged in agricultural activities for at least 10 hours in the week prior to Census day and also persons unemployed during that week but who usually work in agriculture or were then looking for farm work. Work was defined to include self-employment and unpaid work; household chores were excluded, but the labor of women working in cottage industry and handicrafts was included [8].

Obviously such raw data say nothing useful about the homogeneous workdays actually available in agriculture. To arrive at a pragmatic figure we must greatly refine the Census term "economically active" before we can estimate how many work units are really available. Although in the course of this process we exclude many persons listed in the raw Census data, we assume that all those remaining do work full-time—even though the Census figures list every person employed 10 hours per week or more. Thus the estimate we arrive at would claim to be not only a

8. National Statistical Service of Greece, *Results of the Population and Housing Census of* 19 *March* 1961, Vol. III, A: 7, pp. 4-5.

just representation of labor potential but, if anything, a generous one. By this device our final conclusion is strengthened *a fortiori*.

The set we define as labor potential is clearly an intersection of the Census set of "economically active" agricultural population. Our definition excludes the people who engage in cottage industry and handicrafts and also that labor which is done outside agriculture by those who are dually eployed. Dual employment in agriculture and other activities is common in many countries, especially, one could assume, in less-developed economies with a low degree of specialization. Due to lack of statistical data, we made no attempt to classify individuals who work both in agriculture and other occupations. Apart from minor corrections, we assumed that the non-agricultural employment of the "economically active" agricultural population would cancel out, on the whole, the agricultural employment of the persons who have their main occupation outside agriculture and were thus not listed in the Census as agriculturally employed.

In order to cope with the problem of persons who are enumerated in the "economically active" group but contribute only marginally to farm work we excluded the age groups 10 to 14 and 65 and above in both sexes[9]. We thus excluded

9. The Census has recorded 43,300 boys and 32,300 girls 10

people who engage to a certain degree in farm activities but whose lower physical strength, skill, literacy and experience limit the scope of their utilization in other than light and simple farm work. Furthermore, the bias of their exclusion may well be compensated by the somewhat exaggerated assumption that *all* active agricultural population in the age groups 15 to 19 and 20 to 64 in both sexes is available for full-time farm employment. Especially the inclusion of all "active" women in these age groups probably results in an overestimation of the labor potential[10]. On the whole, however, drawing the active farm workers from the age group 15 to 64

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to 14 and 72,000 men and 25,000 women 65 to 74 as «economically active» in agriculture. These figures represent roughly 23 and 78 per cent of males aged 10 to 14 and 65 to 74 and 18 and 21 per cent of females aged 10 to 14 and 65 to 74, respectively. As a percent, however, of the total number of male and female population whom we assumed to be employed full-time in agriculture, they represent a mere 11 and 8 per cent, respectively. The fact that the Census was taken in spring, a season of peak employment, (see section 4) may have resulted in recording as «economically active» a number of secondary workers who usually do not participate in agriculture but only pitch in for a few hours during the peak season. Thus the exclusion of the secondary workers of age 10 to 14 and 65 to 75 may lead to a more pragmatic evaluation of the labor available on an annual basis.

10. P.N. Rosenstein-Rodan estimates that in a family of up to four members one woman is fully occupied in household activities while for families of 5 to 10 members two, and for families of more than 10 members three women are so occupied. (P.N. Rosenstein-Rodan, *op. cit.*, p. 3). On the basis of this assumption, roughly 50 per cent of Greek farm women should not be availa-

is in accordance with a fairly well-established international practice [11].

Our estimates of labor potential in agriculture derive from the 1961 Census data. The lack of information on agricultural employment makes it difficult to adjust the 1961 data in order to derive the 1962 labor potential. We therefore

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ble for farm work at all (Cf. Adam A. Pepelasis and Pan A Yotopoulos, *Surplus Labor in Greek Agriculture*, 1953-1960, Athens: The Center of Economic Research, Research Monograph Series No. 2, 1962, pp. 99-100). Thus, the 622,300 «active» women in agriculture in 1961 should represent less than full-time availability, being roughly 60 per cent of the estimated female population aged 20 to 64. Similarly, the 83,400 «active» girls of age 15 to 19, being roughly 50 per cent of the total female population in that age bracket, should be available only for less than full-time work in the farms if one considers the percentage of students in this number and the number of girls employed in cottage activities, domestic employment and such activities as dowry making.

11. For Greece, Adam A. Pepelasis and Pan A Yotopoulos, *op. cit.*, p. 92, consider 15 to 69 as the range of the working population in farming; K. A. Ferentinos, *I Apodotikotis tis Ellinikis Georgias* (The Productivity of Greek Agriculture), Athens, 1954, p. 16, considers the age group 15 to 65; while the Organization of Agricultural Social Security (OGA) pays pensions to farmers over 65 years of age. For Italy, P.N. Rosenstein-Rodan, *op. cit.*, p. 3, uses the age range 15 to 65 to define the active agricultural population. In studies referring to Asia the active span of life of the agricultural population is invariably shorter because of the inadequate diet of the farmers and other health conditions. John Lossing Buck, *Land Utilization in China*, (Chicago: University of Chicago, Press, 1937), p. 294, adopts the range 15 to 59 for Chinese agriculture; the same range is used for Korean agriculture by Yong Sam Cho, *«Disguised Unemployment» in Underdeveloped Areas*, (Berkeley and Los Angeles: University of California Press, 1963), p. 58.

assumed that there was no change between the two years. Any error involved in this assumption would have tended to overestimate the 1962 agricultural labor force and thus exaggerate the extent of surplus labor[12].

B. *Workdays Available for Agricultural Work.* We defined agricultural labor potential as the work force that is committed full-time to farming. The definition of full-time employment hinges upon the leisure norms to which a society has acceded and is roughly a function of institutional holidays, climatic conditions and the physical strength of the worker in so far as this limits his capacity for work. Since the precise relationship between nutrition and capacity for work is unclear, the determination of full-time employment as a function of the physical strength of the worker includes many imponderables[13]. We therefore chose to distinguish two dimensions in the concept of employment, one the number of workdays per year and another the number of work hours per day. We assumed that the energy level of the worker affects only the number of hours he can

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12. There is a considerable movement of population of working age from the farms to the cities and abroad. While the exact magnitude of this outflow is unknown, it is estimated that for the last few years external migration has surpassed the natural rate of population growth.

13. Harvey Leibenstein, *Economic Backwardness and Economic Growth, op. cit.*, pp. 62-69.

work in one day, and we refrained from explicitly treating this variable in the measurement of labor available. Therefore we derived labor available in terms of workdays per year (rather than work hours) by making certain assumptions only about the number of institutional holidays and the number of days lost to agricultural work because of climatic conditions.

Although there is no rigidly fixed number of workdays in a year, it is clear that for Greece our estimate should first allow for 52 Sundays and 13 official holidays[14]. Thus the upper limit of full working days available for agriculture is set at 300. In general, the lower bound of workdays available should probably allow for two factors: the annual two or three-week vacation that is institutionalized in other employments, and the number of days lost to agricultural work because of inclement weather. The weather factor is especially important in farming, because of the amount of outdoor work involved; work may be impossible not only while it is raining, but also when the humidity and temperature of the soil is not suitable.

Appendix Table 5 presents our conclusions

14. Besides the 13 national holidays, each village in Greece celebrates one or two more local holidays, dedicated to its patron saint. Inclusion of these local holidays as well as of family celebrations and festivals would bring the number of workdays available closer to 290.

on loss of workdays due to institutional and climatic conditions. Because of the temparate climate, freezing weather or snow were not considered. We assumed, however, that rainfall of at least one millimeter, or rainfall that accumulates to less than one millimeter but lasts for more than three hours, usually causes the loss of a full day's work in the muddy fields. When rainfall exceeds 10 millimeters, then one-half of the next day is similarly assumed to be lost on account of soil and road conditions. On the basis of these assumptions there is an average of 90 days lost per year to agriculture because of rainfall. Considering however the probability that some of the rainy days occur on Sundays or holidays, we arrived at a figure of 81 days of inclement weather[15]. To the extent, however, that some agricultural activities (e.g., animal raising or preparatory farm work) are carried out under cover or inside the house, not all inclement weather days mean loss of work.

The actual number of full working days available for agricultural work lies between the upper bound of 300 and a lower bound around 200 days. We adopted the estimate of 260 days. This is higher than the estimates usually employed for

15. Data from the Meteorological Institute of the University of Thessaloniki, and the National Statistical Service of Greece, *Statistical Yearbook* 1959-1960 (Athens, 1960), pp. 9-11.

Greek agriculture but lower than similar estimates employed in case studies of other countries[16]. This is not surprising since different countries are not exactly comparable with one another as far as the institutional leisure or the weather conditions are concerned. In any event, in so far as 260 may be an overestimate our argument is strengthened *a fortiori.*

C. *Coefficients of Conversion into Homogeneous Man Productive Days.* The amount of work accomplished in a full workday is expected to be less for a woman and child than that for a man. By using conversion coefficients to allow for differences in physical strength and work accomplished by different age and sex groups, we convert labor available into homogeneous man-productive days.

We took as the norm (coefficient of 1.0) the workday of an adult farm worker. By definition the coefficient of the population not included in the agricultural labor potential equals 0. The conversion coefficients for the other age and sex

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16. For Greece the existing estimates are as follows: 220 days by the Ministry of Coordination, *Five Year Plan* (Athens: 1960), p. 23; 250 days by Chrysos Evelpides, «Episkopisis tis Agrotikis Economias tis Ellados», (Review of the Agricultural Economy of Greece), *Agrotiki Economia*, Vol. 16, No. 9, (January-March 1957), p. 33; 255 days by K. A. Ferentinos, *op. cit.*, p. 16 and Adam A. Pepelasis and Pan A Yotopoulos, *op. cit.*, p. 103. For Italy, P.N. Rosenstein-Rodan's estimate is 270 days, *op. cit.*, p. 3; for China, John Lossing Buck's estimate is 300 days, *loc. cit.*; for Korea, Yong Sam Cho's estimate is 280 days, *op. cit.*, p. 61.

groups of the labor potential in agriculture range between these two bounds. By mere extension we expanded the use of the coefficient 1.0 also to the male group aged 15 to 19. The overestimate of the work capabilities of this age group may somewhat offset the use of coefficient zero for the persons who are totally omitted from the Census classification of the "active agricultural population". On the other hand, for women 15 to 19 and 20 to 64 we used the coefficients 0.6 and 0.7 respectively.

The utilization of conversion coeffcients, arbitrary though it may appear, has been sanctioned by long use in case studies for different countries at a rather uniform range of values. In comparison, our coefficients are rather on the high side in a delibarate attempt to compensate roughly for any likely defect in inclusiveness of our labor potential data.[17]

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17. In Greece, the coefficients 0.6 for girls and 0.7 for boys and women have been used by K. A. Ferentinos, *op. cit.*, p. 16, and Adam A. Pepelasis and Pan A Yotopoulos, *op. cit.*, p. 102; the coefficients 0.7 for women and 0.5 for children have been used by a 1951 Committee of the Ministries of Agriculture and Coordination and the Agricultural Bank. For Italy, P.N. Rosenstein-Rodan (*op. cit.*, pp. 3-4), and dell'Angelo («Note sulla sotoccupazione nelle agiende contadine», Giuffrè Editore: Roma, 1960, p. 75), use the coefficients of 0.5 for children and 0.6 for adult women. For Korea, Yong Sam Cho (*op. cit.*, p. 68), uses the coefficient of 1.0 for boys and adult male workers alike, and 0.6 for adult women and girls.

D. Results and Cautions.

Table 1 gives our estimate of labor available in Greek agriculture for 1962 of 396,877 thousand man-productive days. This is broken down into 270,608 thousand man-productive days of male labor and 126,269 thousand man-productive days equivalent of female labor.

TABLE 1

LABOR AVAILABLE IN GREEK AGRICULTURE, 1962

Sex	Age	Labor Potential	Technical Coefficient	Workdays (in thousand)	Technical Coefficient	Man Productive Days (in thousand)
Males	15–19	106,800	260	27,768.0	1.0	27,768.0
	20–64	934,000	260	242,840.0	1.0	242,840.0
Females	15–19	83,400	260	21,684.0	0.6	13,010.4
	20–64	622,300	260	161,798.0	0.7	113,258.6
Total		1,746,500		454,090.0		396,877.0

Obviously, the validity of our figures depends on the soundness of our assumptions. In the determination of the labor available, the important assumptions are: (1) the measurement of the 1962 labor potential using the figures of the 1961 Census for males and females 15 to 65 years of age "economically active" in agriculture; (2) the estimate of 260 workdays in a year; (3) the conversion coefficients of 1.0 man-productive day for men and 0.6 and 0.7 for women 15 to 19 and 20 to 64, respectively.

Admittedly there may be a degree of error involved in our assumptions, and to that extent the estimate of excess labor we will derive may be inexact—towards the higher rather than the lower side, we feel. In general, however, it seems reasonable that the assumptions used in the derivation of the labor available may have not seriously affected the reliability of our results, as far as they mainly refer to secondary agricultural earners. Women, partially dependent minors, and retired persons, roughly speaking, are persons whose membership in the labor force is conditional, depending upon a variety of factors in addition to their own health—for example, the age of the children in the family, illness in the family, school vacations and the urgency of the tasks to be done. To a large extent this secondary agricultural labor force constitutes a reserve which is drawn upon when the need arises, particularly for peak season employment, farmyard chores and other tasks that the regular male workers could not or would not handle simultaneously with their main work. We may hypothesize that such contribution to farm work depends, to some degree at least, on the existence of marginal seasonal workloads or marginally productive farm tasks. The agricultural employment of this secondary labor force does not directly compete with employment opportunities elsewhere; rather it is a funtion of the availability of such employment possibilities on the farm.

3. LABOR REQUIRED IN AGRICULTURE

We estimate agricultural labor requirements separately for farming, husbandry, forestry and fishing. Labor required is derived as a vector of two variables—the size of the agricultural activity and a labor-input coefficient. This is done on the basis of the following assumptions and definitions for each sector:

A. *Farming*. The relevant labor intensity coefficient is applied to the area cultivated with each crop in 1962 in order to provide the labor requirements by product category. The detailed operation appears in Appendix Table 1.

Conceptually, the labor intensity coefficients are product specific labor inputs estimated through work studies by agricultural experts in Greek farms of different sizes and locations. The research team which worked on the derivation of our set of labor intensity coefficients made use of a number of work studies carried out in the post-war period,[18] which it adjusted and supplemented with an extensive empirical investigation conduct-

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18. Chrysos Evelpides, *op. cit.*, pp. 34-40; the same, *I Georgia tis Ellados* (The Agriculture of Greece) (Athens: 1944), p. 30; Adam A. Pepelasis and Pan A Yotopoulos, *op. cit.*, pp. 107 ff.

ed throughout Greece in 1961 and 1962. The crops grown in Greece in 1962 were classified in 30 categories. The labor coefficient for each crop is constructed so that it represents the "basket" of all farm enterprises in Greece producing the crop, even under different conditions of land fertility, irrigation, mechanization, technology and yields.

The dimension of the labor intensity coefficient is man-workdays per stremma (equal to 0.247 acres). The workday is nine hours *net* which, after including the time needed for commuting from the village to the farm and transporting supplies and agricultural products between the two, is well over 10 hours a day.[19]

One item that this construction of labor intensity coefficient neglects is the trips necessary between the farm and the city for marketing and delivering the agricultural products, purchasing fertilizers and supplies, obtaining loans, consulting extension services, applying for licenses, and similar "overhead" activities. To account

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19. It seems that on the average 1.5 hours per workday are lost in transportation in the Greek farms. This brings the average length of the working day for the farmer to 10.5 hours. Cf. Leland G. Allbaugh, *Crete, A Case Study of an Underdeveloped Area*, (Princeton, New Jersey: Princeton University Press, 1953), p. 245; Kenneth Thompson, *Farm Fragmentation in Greece*, (Athens: Center of Economic Research, Research Monograph Series No. 5, 1963), pp. 204-205.

for this we included under the general heading "agricultural transports" an arbitrary item consisting of 10 per cent of the total labor required for farming. This seems to be a conservative estimate as compared to the figures in existing studies.[20]

B. *Husbandry.* The relevant labor intensity coefficient is applied to the size of the livestock population in 1962 in order to provide the labor requirements by animal category. The detailed operation appears in Appendix Table 2.

The husbandry labor intensity coefficients are estimated by the team of experts in the same way as the ones for farming. They represent man-workdays per head of animal. By the same reasoning as we used in the case of farming, we have increased the total labor required for husbandry by 10 per cent to account for related activities; we include this under the general heading "agricultural transports".

C. Forestry and Fishing. The forestry labor intensity coefficients are expressed in terms of man-workdays required per weight or volume unit of yearly production. To compute the "agricultural transports" pertaining to forestry we added

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20. Chrysos Evelpides («Episkopisis tis Agrotikis Economias tis Ellados», *op. cit.*, p. 40), estimates that agricultural transports occupy 15 to 25 per cent of the total number of wage days of farmers and draught animals.

an arbitrary but conservative 30 per cent of the total labor required[21]. The results appear in Appendix Table 3.

There is no available recent information on employment or labor inputs for fishing. The estimate of Appendix Table 4 is based on 1955 figures for employment in fishing[22], arbitrarily adjusted to reflect the increase in production over the last years. Ocean fishing (with an output of 17,000 tons for 1962) was entirely omitted since it employs only a small number of Greek crews. The error that we may have introduced by the necessarily somewhat cursory treatment of fishing should be rather negligible in the overall picture, given the small volume of labor employed in fishing as compared to total agricultural employment.

D. *Results and Cautions.* The sum of the labor requirements in farming, husbandry, forestry and fishing represents the total labor required in agricultural production. As appears in Table 2 it amounts to 352,950.8 thousand man- productive days in 1962. The gap between labor available and labor required reveals an 11.0 per cent rate of excess labor on an annual basis.

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21. Chrysos Evelpides (*op. cit.*, p. 40), estimates that agricultural transports connected with forestry occupy 30 to 40 per cent of the wage days required for felling, collecting, etc.

22. Adam A. Pepelasis and Pan A Yotopoulos, *op. cit.*, pp. 114, 174-177.

TABLE 2

EMPLOYMENT IN AGRICULTURE, 1962

(thousand man-productive days)

Labor Available	396,877.0
Labor Required(*)	352,950.8
a. Farming	224,458.5
b. Animal Husbandry	115,316.6
c. Forestry	7,175.7
d. Fishing	6,000.0
Excess Labor	43,926.2
Rate of Average Annual Excess Labor	11.07 %

(*) Including agricultural transports.

The accuracy of our measurements again depends on the soundness of our assumptions. At this stage the important assumptions are that each labor intensity coefficient is representative of the "basket" of farm enterprises producing the crop all over the country and that "agricultural transports" can be expressed as a constant percentage of total labor required for farming, husbandry and forestry.

To the extent that a degree of error is involved in our assumptions, our estimate of excess labor may be inexact. We feel, however, that this is relatively small, because the more precarious assumptions refer to items that only marginally affect the quantity of labor required—e.g., the role of transports and fishing.

The reader may feel that some items are missing from the sum of labor requirements—and some indeed are. In particular, the labor devoted to handicrafts and cottage industry has been defined as outside the scope of our investigation of agricultural employment due to the difficulty of constructing the relevant labor intensity coefficients and to the total lack of data on the production of the farm industries. With reference to household repairs and various kinds of improvements the impression of omission from the labor required is only patrially correct. Tasks that can be performed inside the house were presumably allowed for in our estimate of 260 workdays per year. When inclement weather prevents the farmer from working in the field one can assume that some work related to his agricultural operations is being done at home under cover. In the case of land improvement and irrigation, fence building or construction, for example, the same cannot be said. Admittedly, this factor has entirely evaded our calculation. The practical reason is that such activities are often highly elusive and cannot be measured safely. Another reason is that, at least in some cases, it is conceptually difficult to define such activities. Is building a barn, for example, agricultural activity or is it part of the building industry? Or, when a farmer uses his free time to build his neighbor's barn for wages, does this mean that his agricultural occupation keeps him fully employed? This problem suggests that our estimates of excess labor, albeit biased toward the conservative side, should not be construed as representing *idle* time for the farmer. They show the extent to which agricultural labor is not employed in strictly agricultural work.

4. SEASONAL DISTRIBUTION OF LABOR AVAILABLE AND LABOR REQUIRED

The seasonal nature of agriculture has been totally neglected in the preceding discussion. The labor available and labor required have been expressed in terms of man-productive days per year; their difference represents *the average annual excess labor*. But this is a measurement without any practical significance for certain kinds of policy questions. The existence of average annual excess labor does not, for example, warrant the conclusion that along with the increase in the marginal product of labor due to a withdrawal of workers from the farms, there will be an increase in the quantity of labor supplied per farm worker (and hence only a slight decrease in agricultural output) if there is one season, say spring, when labor requirements have reached or surpassed the full employment norm. The inadequacy of the concept in this respect is that it overlooks the seasonal nature of agricultural operations by averaging the seasonal employment peaks and troughs.

Labor requirements, for example, vary with different seasonal operations, and a distinction must be drawn between "preharvest labor" and "harvest labor". In order to take account of this crop-cycle pattern, excess labor should be reckoned in terms of the four seasons.

On the side of labor availability, a seasonal distribution of the days lost for agricultural tasks due to rainfall, Sundays and holidays is required. Appendix Table 5 shows the seasonal distribution of an average of 90 days of rain. The data are thirty year averages of observations at four meteorological stations: Athens, Argostolion, Heraklion and Thessaloniki. Because of lack of additional data we assume that this distribution is typical for the country as a whole. After computing the probabilities that some of the rainfall days overlap with Sundays or holidays, the number of rainfall workdays is reduced from 90 to 73.7. An additional 7.4 workdays are lost because the quantity of rain accumulated in the previous day makes impossible work in the muddy fields[23]. The total of 81.1 workdays lost because of the weather conditions is seasonally distributed as in Appendix Table 5. To these are added 65 days lost to work because of Sundays and holidays distributed as in the table. The difference between

23. *Supra*, section 2.

the number of workdays in each season and the total number of days lost gives the seasonal distribution of the days available for agricultural work. These are found to be 25.1, 20.0, 23.7, and 31.2 per cent of the total days available for fall, winter, spring and summer, respectively.

The seasonal distribution of labor requirements is derived in the same manner as the labor intensity coefficients. For the case of farming, seasonal labor requirements were computed by empirical investigation for each of the 30 crop groups. They express the seasonal proportion of total labor required for each cultivation on the basis of the work-load characteristics of each crop. For animal husbandry, the seasonal distribution of work requirements was estimated summarily at 24, 27, 27 and 22 per cent, respectively, for fall, winter, spring and summer. For forestry, the estimate is 30, 20, 25 and 25 per cent of the total labor inputs for fall, winter, spring and summer, respectively. Last, for fishing, it was assumed that annual labor requirements are distributed equally among the four seasons, except for the winter catch (16 per cent as compared to 28 per cent for the other seasons). For agricultural transports, a linear homogeneous production function of the first degree was assumed to exist both annually and seasonally. The seasonal distribution of the total wage days required for transports was taken to be proportional to the seasonal employment in agriculture. The "agricultural transports" coefficients of 10 per cent for farming and husbandry and 30 per cent for forestry were taken to apply both to annual total and seasonal subtotal labor requirements.

The detailed results of the breakdown of labor requirements in agriculture into seasonal terms appear in Appendix Table 6.

5. CONCLUSIONS AND SUMMARY

The Employment Diagram of Table 3 presents the seasonal breakdown of excess labor for 1962. Greek agriculture, as one might expect, is characterized by a heavily seasonal pattern. Summer and winter have the highest degree of excess labor, 22.0 and 19.6 per cent, respectively. On the other hand, spring and fall present the lowest seasonal excess labor of 0.2 and 0.9 per cent, respectively.

The seasonal distribution of excess labor is linked to two important factors connected with the nature of agriculture. First, a biological or technical factor, given the type of cultivation, varies the amounts of labor inputs required, irrespective of the supply of labor. Second, institutional (holidays) and climatic (inclement weather) factors reduce unevenly the number of days available during each season.

The lowest component of seasonal excess labor

TABLE 3

EMPLOYMENT DIAGRAM IN AGRICULTURE, 1962

(in thousand man-productive days)

	Fall	Winter	Spring	Summer	Total
1. Labor Available	99,616.13	79,375.40	94,059.85	123,825.62	396,877.00
2. Labor Required	98,726.26	63,775.38	93,880.34	96,568.88	352,950.86
a. Farming	61,106.86	27,495.22	53,882.65	61,568.47	204,053.20
(Transports)	(6,110.69)	(2,749.52)	(5,388.26)	(6,156.85)	(20,405.32)
b. Animal Husbandry	25,159.99	28,304.99	28,304.99	23,063.33	104,833.30
(Transports)	(2,516.00)	(2,830.50)	(2,830.50)	(2,306.30)	(10,483.30)
c. Forestry	1,655.94	1,103.96	1,379.95	1,379.95	5,519.80
(Transports)	(496.78)	(331.19)	(413.99)	(413.98)	(1,655.94)
d. Fishing	1,680.00	960.00	1,680.00	1,680.00	6,000.00
e. Agricultural Transports	9,123.47	5,911.21	8,632.75	8,877.13	32,544.56
3. Excess Labor	889.87	15,600.02	179.51	27,256.74	43,926.14
4. Rate of Average Annual Excess Labor					11.07 %
5. Rate of Seasonal Excess Labor	0.89 %	19.65 %	0.19 %	22.01 %	
6. Rate of Minimum Annual Excess Labor					0.19 %

we define as *minimum annual excess labor.* This in our test is 0.2 per cent for spring. We would expect the supply of labor to be more elastic the higher the rate of minimum annual excess labor. If farmers have not reached the institutional full employment level, we would expect that a certain increase in their marginal product (due to withdrawal of labor from agriculture) would provide an incentive for longer and harder work, so that only a slight decrease in total agricultural output would ensue. On the other hand, lack of minimum annual excess labor (or seasonal labor "shortage") indicates that the supply of labor is rather inelastic. Farmers who have already reached the full employment norm are least prone to increase the quantity of labor they supply in response to an increase in the marginal productivity of labor. Hence the result of a withdrawal of labor from the farms would be a considerable decrease in total agricultural output. Of course, this result may be altered by a change in institutions. Should society redefine the full employment norm upwards, the degree of minimum annual excess labor would increase; then, farmers would be willing to work harder to compensate for any decrease in the quantity of labor employed through the withdrawal of workers from the farms.

The conclusion of our empirical test is that, the degree of minimum annual excess labor being insignificant, Greek agriculture in 1962 operated on the rather inelastic part of the labor supply curve. Any withdrawal of labor from agriculture, if it were not compensated for in other ways, would be attended by a significant decrease in total agricultural output.

Let us now briefly summarize our argument. In Part I we offered a theoretical approach to the concept of excess labor. By the use of a graphical model we attempted to show that withdrawal of workers from agriculture would be inevitably followed by a decrease in agricultural output. The extent of this decrease depends upon the elasticity of the supply curve of labor. We then proposed to evaluate this elasticity indirectly by measuring excess labor. In Part II we defined excess labor as the difference not between some arbitrary norm and yearly work time, but rather between the total labor actually available and the total labor required to maintain present output. We then tried to make these terms operational by determining how much work could be supplied full-time by all those really commited to agriculture, using labor intensity coefficients to estimate the agricultural labor presently required in Greece. By measuring the *minimum seasonal annual excess* labor we deduced the elasticity of the supply curve of labor prevailing in Greek agriculture.

The reader will see that the operational treatment presented in Part II stands quite independently of the theoretical discussion in Part I. Part II tries to determine quantitatively whether there exists in Greece excess labor to such an extent that it can be withdrawn with only little repercussion upon agricultural output. The answer is clearly no. Admittedly, a number of errors and a degree of arbitrariness must have crept into the test. But where discretion was allowed an effort was consistently made to overestimate, rather than underestimate, the degree of minimum annual excess labor. We feel that the remaining margin of error is innocuous. In any case, even if the results of our test are adopted as suggestive evidence only, we feel there can be no doubt that the literature claiming "perfectly elastic supplies of agricultural labor" or degree of dispensable excess labor from 20 to 45 per cent for Greece, is vastly exaggerated.[24]

This lack of excess labor might seem to contradict the prevailing low level of income in Greek agriculture. How can we reconcile the full-employment, the hard and unceasing toil of the farmer with his extreme poverty? This is precisely

24. For literature references cf. Adam A. Pepelasis and Pan A Yotopoulos, *op. cit.*, pp. 57-66.

the point. Farm poverty does not emanate from lack of employment opportunities. Rather it is due to the low value of the marginal product of agricultural labor. In effect, this makes the battle for development more formidable. The answer does not lie in the facile shifting of workers from the agricultural to the industrial sector. One cannot simply steal from Peter to pay Paul, even on an elastic supply curve! Nor is it possible to improve farm incomes by simply investing more capital funds in agriculture. For capital inflow increases the marginal product of the farms only to the extent that capital substitutes for labor—and it creates technological unemployment. The only solution must come through shifting the entire marginal productivity curve to the right by introducing improved technology, innovations and skills and by increasing the investment in the "non-conventional" factors of production, in particular, education. And it is so much for the worse that development is not just a question of capital which, it seems, has a much shorter gestation period than investment in technology, innovations, skills and education.

APPENDIX

APPENDIX TABLE 1

FARMING: LABOR INTENSITY COEFFICIENTS, AREA CULTIVATED AND LABOR REQUIRED, 1962

Products	Labor Intensity Coefficients (man workdays per stremma)*	Cultivated Area (stremmas)*	Labor Required (thousand man-productive days)
1. Wheat	1.85	10,914,718	20,192.2
2. Barley-Oats	2.00	3,176,612	6,353.2
3. Maize[1]	4.18	1,781,249	7,445.6
4. Rice	8.35	187,384	1,564.7
5. Other Cereals[2]	4.50	385,385	1,734.2
6. Pulses[3]	3.20	824,837	2,639.5
7. Tobacco[4]	34.00	1,250,000	42,500.0
8. Cotton non- irrigated	6.50	579,330	3,765.6
9. Cotton irrigated	8.80	1,476,970	12,997.3
10. Sesame seed	2.40	212,539	510.1
11. Other industrial crops[5]	5.50	128,967	709.3
12. Vegetables[6]	11.00	900,188	9,902.1
13. Potatoes[7]	9.00	333,412	3,000.7
14. Melons[8]	8.00	292,605	2,340.8
15. Currants[9]	18.00	432,400	7,783.2
16. Sultanas[10]	23.00	261,700	6,019.1
17. Table Grapes[11]	15.00	167,840	2,517.6
18. Vineyards	8.50	1,417,000	12,044.0
19. Citrus Fruit[12]	15.00	230,000**	3,450.0
20. Fruit[13]	11.50	530,000**	6,095.0
21. Olive Groves[14]	3.90	5,350,000**	20,865.0
22. Dried Fruits	5.50	300,000**	1,650.2
23. Sugar Beets	13.00	64,448	837.8
24. Cattle Feed Legumes[15]	3.10	872,142	2,703.6
25. Grain Fodder	2.30	506,967	1,166.0
26. Hay Fodder	3.50	1,505,628	5,269.7
27. Alfalfa[16]	8.00	825,495	6,604.0
28. Natural Grass	2.00	345,657	691.3
29. Fallow	0.10	2,010,580	201.1
30. Other Crops[17]			10,500.0
Total		37,264,035	204,053.2
Agricultural Transports for Farming (10 %)			20,405.3
TOTAL			224,458.5

* One stremma is equal to 0.247 acres.

** Data for 1961.

S o u r c e : Adam A. Pepelasis, *Labor Shortages in Greek Agriculture*, 1963-1973, (Athens: The Center of Economic Research, Lecture Series No. 8, 1963) p. 62.

N o t e s : The specific crops or varieties with their respective labor inputs follow:

1. Maize non-irrigated 3.90; maize irrigated 4.80; maize in crop rotation 5.10.
2. Rye 2.30; maslin 2.20; sorghum; millet.
3. Beans 3.30; broad-beans 3.10; lentils 1.90; chick-peas 1.80; peas 2.20; lathyrus 3.10.
4. Tobacco for local consumption 22.50; Xanthi export tobacco 42.00; Yiakades Seron export tobacco 38.00; Komotini export tobacco 40.00.
5. Ground nuts; sunflower; flax for fiber; hemp; sorghum; mastic; anise seed; red pepper.
6. Tomatoes, early crop, non-irrigated 7.80; early crop irrigated 9.20; late crop, irrigated 12.60. General summer vegetables, early crop 10.80; summer vegetables, late crop 14.00; winter vegetables, 6.00. Also, cabbage; cauliflower; lettuce; chicory and endives; spinach; dry and fresh onions; dry and fresh garlic; tomatoes; shiny beans; squash; cucumbers; egg plant; chillie; okra; pickling cucumbers, beets; artichokes.
7. Potatoes, early crop, non-irrigated 5.60; early crop, irrigated 9.20; late crop, irrigated 16.00.
8. All melons (water melons and musk melons), non-irrigated 7.60; irrigated 8.80.
9. Messini currants 16.00; Elia currants 18.00; Achaia currants 22.50.
10. Crete raisin sultana 20.00; Corinth raisin sultana 25.00.
11. Crete table grapes 16.00; Corinth table grapes 18.50; rest 12.00.
12. Oranges 14.00; lemons 16.00; tangerines 15.00; bitter oranges.
13. Apples 11.70; pears 12.50; peaches 11.70; apricots 12.50; cherries 8.50; sour cherries 8.50; quinces 8.50; plums 8.50; figs 8.50; prunes 8.50.
14. Olive oil 3.10; olives 5.00.
15. Vetch; bitter vetch; lupine; vetching; peas.
16. Alfalfa fodder 7.50; alfalfa seeds 10.50.
17. The labor intensity coefficients apply to regular plantations and systematic crops and are expressed in man-productive days per stremma. An additional 10,500 thousand man-productive days was included to account for scattered trees and other garden crops for which area estimates do not exist.

APPENDIX TABLE 2
ANIMAL HUSBANDRY: LABOR INTENSITY COEFFICIENTS, LIVESTOCK POPULATION AND LABOR REQUIRED, 1962

Products	Labor Intensity Coefficients (man work-days per head of animal)	Livestock Population (thousand heads)	Labor Required (thousand man-productive days)
Horses	16.1	324.0	5,216.4
Mules	13.7	224.0	3,068.8
Donkeys	6.2	495.0	3,069.0
Cows, Domestic Breed	19.8	730.0	14,454.0
Cows, Improved Domestic Breed	23.9	300.0	7,170.0
Cows, Improved Foreign Breed	28.7	112.0	3,214.0
Buffaloes	19.8	64.0	1,267.2
Sheep	3.7	9,500.0	35,150.0
Goats	3.5	4,870.0	17,045.0
Swine	3.7	665.0	2,460.5
Poultry	0.7	16,500.0	11,550.0
Rabbits	0.8	475.0	380.0
Bees (apiaries)	0.6		328.0[1]
Silk Production (kg)	0.7		460.0[1]
Total			104,833.3
Agricultural Transports for Husbandry (10 %)			10,483.3
TOTAL			115,316.6

1. Estimated from the adjusted trend of the period 1953-1960. See Adam A. Pepelasis and Pan A Yotopoulos, *Surplus Labor in Greek Agriculture*, 1953-1960, (Athens: Center of Economic Research, Research Monograph Series No. 2, 1962), pp. 174-177.

APPENDIX TABLE 3

FORESTRY: LABOR INTENSITY COEFFICIENTS, TOTAL PRODUCTION AND LABOR REQUIRED, 1962

Products	Labor Intensity Coefficients (man workdays per ton or m^3)	Total Production (thousand tons)	Labor Required (thousand man-productive days)
Timber (m^3)	1.50	321.6*	482.4
Charcoal	6.60	18.1	119.5
Fire Wood	0.78	3,172.2*	2,474.3
Resin	31.00	25.6	793.6
Acorns, Pine Tree Bark, etc.	—	—	150.0**
Fire Wood for own consumption	—	—	1,500.0**
Total			5,519.8
Agricultural Transports for Forestry (30 %)			1,655.9
TOTAL			7,175.7

*Data for 1961

**By estimation

APPENDIX TABLE 4

FISHING: TOTAL PRODUCTION AND LABOR REQUIRED, 1962

	Total Production (tons)	Labor Required (thousand man-productive days)
Shore Fishing & Fisheries	13,000	—
Mediterranean Fishing	58,000	—
TOTAL	71,000	6,000.0
Ocean Fishing	17,000	—

APPENDIX TABLE 5
SEASONAL DISTRIBUTION OF DAYS AVAILABLE FOR AGRICULTURAL WORK

	Fall	Winter	Spring	Summer	Total
1. Rainfall days in Greece (30 year average)	21.6	36.0	24.4	8.0	90.0
2. Rainfall days coinciding with Sundays or holidays (probability distributions)	3.6	6.8	4.5	1.4	16.3
3. Rainfall workdays (1. minus 2.)	18.0	29.2	19.9	6.6	73.7
4. Loss of workdays because of rainfall	21.0	29.2	23.2	7.7	81.1
5. Loss of workdays because of Sundays	13.0	13.0	13.0	13.0	52.0
6. Loss of workdays because of official holidays	2.0	4.0	4.0	3.0	13.0
7. Total loss of workdays (4. plus 5. plus 6.)	36.0	46.2	40.2	23.7	146.1
8. Total number of days	91.0	90.0	92.0	92.0	365.0
9. Days available for agricultural work (8. minus 7.)	55.0	43.8	51.8	68.3	218.9
10. Percentage distribution	25.1 %	20.0 %	23.7 %	31.2 %	100.0 %

Source: National Statistical Service of Greece. *Statistical Yearbook of Greece*, 1959, 1960. (Athens: National Printing Office, 1959), pp. 8-11.

SEASONAL DISTRIBUTION OF LABOF

I. Farming	Total Labor Requirements (thousand man-productive days)	Fall %	Fall (thousand man-productive days)
1. Wheat	20,192.20	25	5,048.05
2. Barley-Oats	6,353.20	25	1,588.30
3. Maize	7,445.60	45	3,350.52
4. Rice	1,564.70	45	704.11
5. Other-Cereals	1,734.20	20	346.84
6. Pulses	2,639.50	17	448.72
7. Tobacco	42,500.00	30	12,750.00
8. Cotton non-irrigated 9. Cotton irrigated	16,762.90	45	7,543.31
10. Sesame seed	510.10	30	153.03
11. Other industrial crops	709.30	25	177.32
12. Vegetables	9,902.10	20	1,980.42
13. Potatoes	3,000.70	18	540.13
14. Melons	2,340.80	10	234.08
15. Currants	7,783.20	20	1,556. 64
16. Sultanas	6,019.10	30	1,805.73
17. Table Grapes	2,517.60	30	755.28
18. Vineyards	12,044.50	35	4,215.58
19. Citrus Fruit	3,450.00	20	690.00
20. Fruit	6,095.00	25	1,523.75
21. Olive Groves	20,865.00	35	7,302.75
22. Dried Fruits	1,650.00	30	495.00
23. Sugar Beets	837.80	20	167.56
24. Cattle Feed Legumes	2,703.60	25	675.90
25. Grain Fodder	1,166.00	35	408.10
26. Hay Fodder	5,269.70	30	1,580.91
27. Alfalfa	6,604.00	20	1,320.80
28. Natural Grass	691.30	20	138.26
29. Fallow	201.10	70	140.77
30. Other Crops[1]	10,500.00	33	3,465.00
Total	204,053.20		61,106.86
Agricultural Transports for Farming (10 %)	20,405.32		6,110.69
II. Animal Husbandry	104,833.30	24	25,159.99
Agricultural Transports for Husbandry (10 %)	10,483,30		2,516.00
III. Forestry	5,519.80	30	1,655.94
Agricultural Transports for Forestry (30 %)	1,655.94		496.78
IV. Fishing	6,000.00	28	1,680.00
TOTAL	352,950.86		98,726.26

1. See n. 17 Appendix Table 1.

TABLE 6

REQUIRED IN AGRICULTURE, 1962

Winter		Spring		Summer	
%	(thousand man-productive days)	%	(thousand man-productive days)	%	(thousand man-productive days)
5	1,009.61	20	4,038.44	50	10,096.10
5	317.66	30	1,905.96	40	2,541.28
—	—	15	1,116.84	40	2,978.24
—	—	25	391.18	30	469.41
5	86.71	20	346.84	55	953.81
4	105.58	23	607.08	56	1,478.12
15	6,375.00	25	10,625.00	30	12,750.00
5	838.14	20	3,352.58	30	5,028.87
—	—	25	127.53	45	229.54
5	35.47	30	212.79	40	283.72
20	1,980.42	30	2,970.63	30	2,970.63
20	600.14	30	900.21	32	960.22
—	—	45	1,053.36	45	1,053.36
15	1,167.48	35	2,724.12	30	2,334.96
15	902.86	35	2,106.69	20	1,203.82
15	377.64	35	881.16	20	503.52
15	1,806.67	35	4,215.58	15	1,806.67
20	690.00	35	1,207.50	25	862.50
10	609.50	25	1,523.75	40	2,438.00
40	8,346.00	20	4,173.00	5	1,043.25
10	165.00	20	330.00	40	660.00
10	83.78	30	251.34	40	335.12
2	54.07	3	81.11	70	1,892.52
—	—	55	641.30	10	116.60
5	263.49	55	2,898.33	10	526.97
—		30	1,981.20	50	3,302.00
—		10	69.13	70	483.91
—		—		30	60.33
16	1,680.00	30	3,150.00	21	2,205.00
	27,495.22		53,882.65		61,568.47
	2,749.52		5,388.26		6,156.85
27	28,304.99	27	28,304.99	22	23,063.33
	2,830.50		2,830.50		2,306.30
20	1,103.96	25	1,379.95	25	1,379.95
	331.19		413.99		413.98
16	960.00	28	1,680.00	28	1,680.00
	63,775.38		93,880.34		96,568.88

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