Analysis of farm size with special reference to Iowa

Earl Orel Heady

Iowa State College

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ANALYSIS OF FARM SIZE

WITH SPECIAL REFERENCE TO IOWA

by

Earl Orel Ready

A Thesis Submitted to the Graduate Faculty for the Degree of

DOCTOR OF PHILOSOPHY

Major Subject: Agricultural Economics

Approved:

Signature was redacted for privacy.

In Charge of Major Work

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Dean of Graduate College

Iowa State College

1945
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INTRODUCTION

This study deals with certain problems of farm size, problems which are not new but which have not received the study which they merit. Interest in these problems has come to the fore sporadically in the past few decades. In the United States discussions relative to farm size reached their initial peak in the 1920's, slackened during the depression of the early 1930's and revived again in the late 1930's and early 1940's. Other agricultural problems have been foremost since the outbreak of the war but the subject of farm size has not been submerged. It promises to be a matter of general concern once postwar adjustments are at hand.

The subject of farm size is one which has received more attention by the farm management research worker than by any other agricultural economist. Even then it has usually been considered along with a multitude of other factors and the typical farm management study devotes no more than one or a few paragraphs to the subject. Students of agricultural policy have largely skirted the entire problem area. The general economist has set forth certain principles as to the size of the farm but these lost part of their meaning in agriculture because of the special conditions prevalent in the industry. Newspapers, farm magazines and semi-popular writers have made many predictions relative to farm size trends but few of these have been supported by data of any sort.

Certain problems of farm size either are or should be the concern of several groups. They are of special interest to the farm operator,
He is concerned with adjustments in farm size as a means of increasing his income, with the importance of farm size relative to other factors as a force affecting farm income and with the returns from intensive expansion as compared to extensive expansion. Further, some farmers are intensely concerned with changes in farm size from a different angle. Any material increase in the land area per farm has its ramifications in a decreased number of farms and farm families. The latter is likewise of special interest to the small town businessman, the school district, the church or other institutions which are deeply rooted in a rural economy.

Farm size has received little attention from students of agricultural policy. Yet there is no reason why this should be so. Research workers in this field have, in a search for means of supplanting farm incomes in a manner consistent with the general welfare, devoted major efforts to such studies as pricing policy. Certainly adjustments in farm size represent a means of achieving or maintaining adequate farm incomes in a manner consistent with the best use of the nation's resources. Yet some students of policy shrug this off with the statement that society is in favor of family-sized units. An adjustment in farm size may not necessarily presage doom to the family unit. Perhaps it more nearly requires an adjustment to bring many units up to a family size, both from an income and labor use standpoint. The student of agricultural policy should have this and other basic knowledge before he investigates other means of treating agriculture's income problem. For example, he should know whether farm size adjustments would result
in adequate farm income while allowing agriculture to stand on its own feet on a price basis. He should at least know whether size adjustments would require more or fewer family farms. This information is basic for the formulation of sound national policies.

This study focuses on two somewhat related but still different problems of farm size. The first has to do with trends in farm size as measured by acres. The second has to do with the relationship of income to farm size as measured in any manner whatsoever. In addition, the study includes a more general and deductive section dealing with the economics of farm size. It was not originally planned that the last mentioned section would be included in this study. However, after the review of literature and the analysis of farm size trends in Iowa had been completed it was felt that there was a dire need for something of this nature.

It is hoped that this study can be used to furnish basic information to farm operators, students of agriculture and other groups directly affected by trends in farm size and by the relationship of income to farm size. Further, it is hoped that it will be of some value to those concerned with devising sound national policy.
REVIEW OF LITERATURE

Changes in size and the relationship of income to size are inter-related problems in the theory of the firm. However, since these two problems have ordinarily been studied separately in agriculture the review of literature follows a similar demarcation. The literature cited does not exhaust the list. Only enough different citations are given that an understanding of the literature is possible. Research studies and popular articles mentioned were selected as representative of (1) different periods of time, (2) different types of studies, and (3) the viewpoints of different individuals.

Changes in Farm Size

Interest in the problem of changing farm size did not come to the fore in the United States until a relatively few years ago. This is easily explainable. There was no reason to be alarmed over changing farm size as long as a pioneer frontier existed. The individual who aspired to farming had the opportunity of moving to an unsettled region. Once lands suited to farming were fully settled, however, interest in farm size was kindled. Any marked increase in average farm size must now be accompanied by a decrease in the number of farms. Too, another development followed close upon the heels of a near-full land settlement. New machines were being invented and old inventions were being improved.
These two things, exhaustion of the supply of public lands suitable to farming and the development of mechanization, brought forth much interest in farm size especially during the 1920's. Any change in farm size resulting from mechanization was certainly in the initial stage. Yet many predictions and speculations as to future trends in farm size were made. There was, of course, little if any data to support the many contentions. Most writers were drawing a parallel between agriculture and other industries in which mechanization had occurred. Many of the predictions and opinions were contradictory. Even today, some fifteen to twenty years later, the same type of prediction is being made.

Wells (85) was one of the first to suggest that agriculture should be organized on a large scale basis similar to that of other industries. Writing in 1889, he stated that the best authorities in the United States and Europe were coming to believe that the only possible future for agriculture was to be found in large scale units, operated with ample machinery and with labor organized somewhat after the factory system. He looked upon the small scale methods of farming as shiftless and wasteful. Grantham (25) wrote an article in 1919 pointing out certain advantages of big farms over small farms. He mainly emphasized the advantages of buying and selling in large quantities which result for large farms organized under central management. Apparently he expected these advantages to result in a rapid increase in the number of very large farms.
Another early comparison of the large and small farms was made by Coulter (14) in 1910. He stated that the bonanza farms in the Red River Valley of North Dakota had an initial advantage over the small farms. They were able to secure both rebates on grain shipped in large quantities and wholesale prices for lumber and goods purchased in large quantities. The initial advantage was great but this ascendance of the bonanza farm was only temporary according to the author. Small farms made steady progress and were gradually able to utilize land and equipment as economically, or nearly so, as the bonanza farmers. He concluded that the small farm would eventually net greater profits because of the ability of the family to care for more details and that it is most successful as a basis for production and as a sound foundation for a nation of agricultural homes. Similar conclusions based upon an analysis of large land holdings in North Dakota were made by Benton (6) in 1925. Neither of these studies had official data to support their conclusions but were chiefly generalizations based upon a few observations.

Henry Ford (15, 23) made suggestions and predictions as to large-scale farming as early as 1924. He looked upon the small-scale livestock production of the individual farm as highly inefficient. Raising livestock in small units was, according to his views, an utter waste of time and effort. He first suggested that if farmers were to pool their livestock herds they could earn far more than by tending small herds of their own. At the same time he suggested that crop production be only a part-time job combined with industrial work. Later he suggested that dairy farming be performed by corporations. In 1926 he predicted
that either the large-scale corporation would supersede the individual farmer or that groups of farmers would be forced to combine and perform their work in a wholesale manner. This, he thought, was as it should be if the industry were to prosper.

The years 1928 and 1929 brought forth a veritable deluge of writings on farm size. Hundreds of speeches, press articles, and even some journal articles made their appearance. These, like those of previous years, were predictions of things to come in the way of farm size and forms of business organisation in agriculture. However, agricultural economists as well as business men, farmers, farm leaders and legislators began setting forth their views. Previous to this time most had been said and written by the latter groups. Empirical studies of farm size changes were still non-existent. The development of mechanisation was the important factor in bringing about this large flow of predictions.

Some writers suggested that mechanisation would force the large-scale unit or the corporate form of business organisation in agriculture. Not all of these looked upon the development as desirable. App (3) expected large-scale and corporation farming to develop at a rapid rate and although it would enhance farm prosperity it would not replace the family farm entirely. Mead and Ostrolensk (50) predicted that the efficient large-scale producers would drive out the small-scale producer even though the latter is also efficient. Nourse (58) expected that although the farm was not so well adapted to large-scale production as other industries a three or four man farm would allow efficient utilisation of machinery and labor.
Another group of writers looked upon large-scale and corporation farms with favor. McMillen (47) was one of these. He foresaw corporation farming as containing enormous possibilities for improving the economic and social status of farmers. By this means he suggested that farming might be put on a parity with industry and that farm incomes might be made comparable to urban incomes. The chief difficulties of agriculture were, according to his views, to be found in too little capital and too many people. The corporation, greater capital, larger units and fewer persons in the industry would largely solve this. He doubted that a family unit too small for an adequate income was worth preserving. He also thought that some persons over-emphasized the independence of the family farm as a justification of its existence. Since the executives of corporations, for example, were paid employees but retained certain freedoms. Rowley (62) argued for corporation methods in agricultural production as a means of increasing the efficiency of the industry and of solving the income problem. He expected greater returns due to (1) the greater economy in the use of feed, labor and fixed capital, (2) buying and selling advantages, and (3) a greater specialization of labor. Davidson (17) thought that relatively large-scale units would mean not only technical efficiency but would also invite a better quality of management and that "the best possible social conditions will be provided for the community. There will be good schools and there will be community spirit. This is the type of farming we want. It will do away with slums in agriculture".
A third group of persons suggested that displacement of the family by the corporation or large-scale unit was very possible but looked upon this trend as dangerous. Murphy (55) indicated that the 1930 meeting of the American Country Life Association was principally a denouncement of corporation farming. Speakers included Ex-Governor Lowden of Illinois and James Stone, vice-chairman of the Farm Board. Gee (24) suggested that machinery should be used to lessen the drudgery of farm work and that only small increases in farm size should result. He was opposed to corporation farming and indicated that the contribution of the family farm to the American way of life justifies the retention of the family unit. Taber (70) looked upon the development of corporation farming with alarm. Absentee corporate ownership would, according to him, destroy the independence of agriculture, interfere with the training of youth, detract from community life and inject a labor problem into agriculture. According to an editorial in Agricultural Engineering (2) the acceptance speech of former president Herbert Hoover condemning large-scale farming was well accepted by the majority of the farm magazines. The statement which especially brought forth favorable comment was as follows:

Farming is and must continue to be an individualistic business of small units and independent ownership. The farm is more than a business; it is a state of living. We do not wish it converted into a mass production method. Therefore, if the farmer's position is to be improved by larger operations it must be done not on the farm but in the field of distribution.

A fourth group of writers did not envision the corporation as a menace to the family farm. They did, however, expect the family farm
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tasks requires a large degree of responsibility for the individual worker, (2) the seasonal nature of agricultural production does not allow the specialisation of other industries, and (3) there is not a great deal of continuity in operations necessary for mass scale productions. He expected an appreciable increase in the family farm and pointed to the following effects of the large-scale family farm should it develop: (1) Community organisation and life would undergo a fundamental change. It need not, however, be a poorer community life but would most likely be a richer one. A smaller population in proportion to the land and capital should result in a more intelligent and cooperative population and one constituting a better background for the development of worthwhile community enterprises. (2) A higher use of agricultural resources would result. The large units should become training centers in farm efficiency and in rational organisation for farm production and marketing. (3) A greater degree of stability in agriculture would come about. There would be more permanence in the type of farming on rented land and a more rational adjustment of farming to the nature of the land and to the existing economic forces. Such cycles as those for hogs and beef cattle might actually be reduced. (4) Agriculture would develop as a greater power in the councils of the nation as the farm population contains a larger proportion of outstanding and more articulate persons.

Grimes (26) indicated that replacement of the small and medium-sized farm by the large-scale unit was inevitable. By large-scale farming he meant the maximum acreage that one family could farm as a unit. Mechanisation might, of course, allow a doubling or other multiplication
of the number of acres in the family unit. The increase in size would, according to him, be limited to the large family unit because the quantity of labor that can be employed advantageously from one center is usually limited to that which the family can furnish. On the other hand, the size would tend to this limit because of the lower costs which accompany large-scale farming under mechanisation. Grimes also pointed out that the development of large-scale or corporation farming would have far-reaching effects on community life. Such institutions as churches and schools would center more around the small town and less around the farm community. Banks, stores and other agencies in the town would be affected adversely.

The writings reviewed thus far all date back to 1929 or earlier. Recent concern over the prospective disappearance of the family farm is represented by such articles as that of Johnson (41). Writing in the August, 1944, Journal of Farm Economics, he implies that the family farm is in trouble and may become obsolete. The family farm is defined as one which provides a satisfactory family living as well as allowing savings for old age and one on which the labor and management is provided mostly by the family. This author suggests that farmers may well have to adopt the methods of industry if they are to compete in procuring labor and capital and in keeping costs in line with other industries. This general trend toward greater industrialization and the consequent substitution of capital for men will, he suggests, be accompanied by (1) labor policies involving increased public regulation of hours, wages
and working conditions, (2) difficulty of acquiring ownership because of the large capital requirements, and (3) less consideration to soil conservation. The author favors the family farm because it has contributed much to the stability of Corn Belt agriculture; it stands as a symbol of independence and freedom of action worth preserving; it has developed individual responsibility, initiative and a cooperative attitude among all members of the household; and it has resulted in a feeling of community responsibility unequalled by any other type of agricultural organization. He suggests, among other things, that in order to retain the family-sized unit it will be necessary to (1) make a full use of power and equipment, (2) develop more cooperative ownership, custom hire or exchange in the use of equipment, (3) place greater emphasis on the supply and use of operating capital, and (4) use increased incomes for improved efficiency and family living rather than for capitalization into higher land values.

In 1943 Adams (1) summed up a paper read to the Western Farm Economics Association with the statement that, in his belief, the corporation farm enjoyed an economic advantage over the family farms. On the other hand, the author suggested that social gains more often result from the family farm. He suggests that a unit somewhere between the two above extremes may be most profitable. This would call for an appreciable increase in the number of acres per farm.

A very few empirical studies of changes in farm size or in farm size requirements have been made. Paschal et al. (68) indicate that
a unit of 480 acres appears to be the minimum which will support the average family under average weather, prices and management in Central South Dakota. Olson et al. (11) state that 200 acres of wheat and 200 acres of fallow are necessary if common types and sizes of equipment are to be handled efficiently. Hoover (35) made a sample study of consolidated farms in Iowa for 1939 and 1940. He estimated that one-half of one per cent of the farms were consolidated in these two years. Many other estimates of the number of consolidations have been made. Representative of these estimates is that of Hendricks (31) who suggests that 6 per cent of Iowa's farm families were left without a farm over a three year period. A 1940 estimate (15) implied that 5000 Iowa farm families were forced off the land in 1940.

Relationship of Farm Size to Farm Income

The relationship of farm size to farm income was a subject which came into consideration by even the very first writers in agricultural economics. C.F. Warren (83) made one of the first studies dealing with this problem. His study in Tompkins County, New York, prior to 1913 indicated that labor income tends to vary directly with farm size. He suggested that this relationship grew out of the greater efficiency with which the large farm used its labor, horses, machinery and other capital. Three hundred acres were, he thought, near the maximum from a standpoint of profitable operation since "it is not often possible to get more than this amount well located in respect to buildings".
Two other early writers, Carver (9) and Taylor (73) indicated similar relationships between farm size and income. Both felt that the medium-sized farm was more profitable than the large farm. No data were supplied as proof that large farms are unprofitable.

An Iowa study (54) based on 1915 and 1919 data concluded that larger farms usually result in higher labor incomes and that a farm should be of at least 160 acres or even 240 to 350 acres if horses and machinery are to be used most efficiently. Taylor and Hurd (71) found that there was a positive relationship between farm size as measured in acres and farm profits for the years 1913 and 1918 and a negative relationship for 1921.

Mitchell (61) in a 1924 study of farm organization and factors affecting profits on farms in northeastern Iowa devoted eight lines to farm size. He concluded that the most profitable farm area seemed to be about 160 acres but that the effect of size on profits was not great either for losses or gains in any of the size groups. This last statement is confusing since the effect of size should be important between and not within size groups.

The Iowa Annual Farm Business Association summaries (37) show both greater management returns and a greater net operator income on farms of large acreage except for the years 1930, 1931 and 1932. No attempt is made in these summaries to rank the importance of farm size as a factor affecting farm income. Part of the lower income on the larger farms in the depression years is explainable in the decrease in inventory values of the greater amount of capital.
Pond (61) indicates that farm size is one of the most important factors affecting farm income in Minnesota. This conclusion is based on a summary of 1940-43 records kept by farmers. During favorable years the relationship between income and acres in farm is positive. During unfavorable years, the relationship may well be negative according to the summary of this study.

Hopkins (56) states that net farm income increases with total acreage up to about 400 acres and then turns downward as the farmer's managerial ability is (generally) spread over a greater area than he can handle effectively with present equipment and under the present forms of farm organization. He also states that net farm income reaches a maximum as corn acreage approaches 140 acres in rough areas of Iowa and at a maximum of 180 acres for level areas; net farm income increases with hogs produced up to about 35 litters and with cattle fed up to 160 head. These figures are based on farm accounting data for the years 1927, 1928, 1929 and 1930. It is entirely possible that the farm which had reached a maximum corn acreage on the basis of these averages also had a maximum number of hogs, beef cattle or dairy cows.

Mosher and Case (53), in a study of 57 farm records for the nine-year period, 1925-34, concluded that farm size was unimportant as a factor affecting farm income. The measure of size employed was acres. There is some doubt as to the validity of the method used. Actually there was little variation in the size of farms studied. The lower group averaged 234 acres as compared to 244 for the higher group. Other tables in the same study suggest a relationship between size and income.
Other summaries of Illinois farm record data show a positive relationship between farm acres and income. For example, a 1942 summary of 12 years' records (16) indicates that farm size as measured in acres was closely related to farm income and the rate earned on investment.

Warren and Cunningham (84) indicate that farm size was a more important factor affecting New York farm income in 1943 than for previous years. The measure of size used was productive-man-work units. An examination of the study would suggest that this conclusion may have come about somewhat as follows: The farms were broken down into four size groups for 1943 and for previous years. The average incomes of these four groups were plotted against size and connected by a ruled line. Although both the long-time data and those of 1943 showed a positive inclination, the line for 1943 was highest on the graph. Actually this does not have to mean that farm size was more important in explaining variations in farm income in 1943 than for previous years. The relationship of these two lines means only that a unit of size added more to income in 1943 than for previous years. On the basis of this statistical technique, one could not say that income was more closely associated with size in 1943.

A very few studies directed primarily at the relationship between income and size have been made. McNairns and Cockerill (47) studied the relationship of farm size and farm type to income in one county of New Mexico by use of the budget technique. Farms were grouped by acres and the average annual gross income expectancy (estimate) was drawn up
as an aid in county planning. Harper and Christopherson (27) also
used the budget method to estimate the returns for small, medium-sized
and large farms in the spring wheat area of South Dakota. The authors
look upon farm size as one of the most important factors affecting
success or failure in farming. They classify large farms as those of
600 acres, medium-sized as 400 acres and small farms as 300 acres.
Estimated expenses and income are compared under different systems of
farming for each of the three farm sizes.

Most of the studies cited have one thing in common. The statistical
procedure used has been to sort the farm data according to size,
compute the average income for each size group, then regroup the farms
according to many other factors and show the returns for these groups.
For this reason farm size receives only a small amount of attention in
these studies and no quantitative statements can be made about its
importance.

The type of farm business analysis pioneered by Zimner (74) is
an important exception to this procedure. By means of a more elaborate
statistical technique he derived production functions from 1948 Farm
Business Association records in Iowa. The total product or dependent
variable was gross profits. The factors chosen as the independent
variable were land, labor, farm improvements, liquid assets and working
assets. The regression equation used was a function which is linear
in the logarithms. Four different types of farms were analyzed and a
statistically significant correlation existed in each case. The portion
of the variation in gross profits explained by the independent variables
ranged from 63.8 to 72.7 and averaged 67.1 per cent. The regression coefficients or elasticities indicate the percentage change in gross profits associated with a one per cent change in each independent factor. The marginal productivities were positive in most cases and there were decreasing returns to scale for all types of farms except dairy. Had it been possible to include management in the analysis returns to scale might have been constant.

The statistical technique employed in the above study is indeed a needed step in the direction of refined analysis. However, the practical application may be limited. The farmer is not so much concerned with gross profits as he is with net income. It is entirely possible that an increase in one factor may bring forth a positive increment to gross profits but a negative increment to net income. Scale of operations may well be less closely associated with net income than with gross income. The nature of the relationship may also be altogether different in the two cases. So, the analysis does not provide any one common denominator of size for the study of other problems associated with scale of operation.
been as great a force as was originally supposed or as some are still expected on the part of the people and the government. However, in examination of farm size does seem to suggest the greater horizons of the firm. In the above reasoning implies the existence of the firm. In production cost, neither can the small-scale unit survive by retaining a high fixed investment. Production output of the large fixed cost in the equipment. Furthermore, the large investment is a large fixed cost in the equipment. Furthermore, the large fixed investment is a high threat to small scale output and commodity. Some have reasoned, somewhat as follows: The adoption of mechanization decreases have resulted around mechanization. The large farm properties a major share of the large farm properties.
The writer states that some commodities are competitively priced. The text continues:

"The competition among the suppliers of the same product is so intense that the price of any given commodity is usually determined by the forces of supply and demand rather than by any other factor. The demand for the commodity is usually elastic, so that a small change in the price will cause a large change in the quantity demanded. Therefore, the price of the commodity is determined by the forces of supply and demand, and is not affected by any other factor."
The general outline of this section might well have been different than that followed. The section, instead of being broken down into the two parts indicated, might have been set up as a single theory of firm size within the conditions peculiar to agriculture. However, since the predictions of changing farm size have often implied the unqualified theory of the firm the procedure outlined has been followed.

**Theory of Firm Size**

Theories relative to the size of the firm can be placed into two categories: The first of these deals with the static theory of production as developed by Marshall (49) and refined to a high degree by such individuals as Viner (82), Barrod (28) and others. The second deals with the non-static theory of production of which the work of Nicholas Kaldor (44), Hart (29), Tintner (75) and others is especially representative.

**Equilibrium of the firm under static conditions**

The theory of the size of the firm under static conditions rests largely upon the law of diminishing marginal returns and the nature of the demand curve facing the individual firm. In addition, this analysis presupposes that the firm has access to unlimited resources, that the firm attempts to maximise monetary returns and that the supply curve of certain factors of production is continuous. These elementary points require no further elucidation.
In order to simplify the discussion it may be assumed that the firm is producing a single product. Size will be expressed in terms of output for a given time period. The size of the firm under equilibrium conditions may well differ between the short-run and long-run periods.

Size of the firm in the short-run. The "short-run" is generally understood to mean a period of time in which there exists no opportunity to alter the input of the fixed factor. This definition of short-run automatically establishes the nature of the firm's cost curves for the period under consideration. Costs may be divided into two parts: fixed costs which are associated with the fixed factor and do not vary in aggregate amount with volume of output and variable costs which are associated with the variable factor and which do vary with volume of output. From these two types of costs all the important short-run cost curves may be derived (Figure 1). Average fixed costs (afo), a rectangular hyperbola, must always decline as total output expands since a fixed total amount is always divided by an increasingly large number of outputs. The average variable cost (ave) is a U-shaped curve, falling within the ranges of increasing average returns to the variable factor and rising within the range of diminishing average returns of this factor. Average total cost (atc), the sum of the ordinates of the afe and ave curves, is also a U-shaped curve. It declines for ranges of output in which either both ave and afe are declining or in which afe is decreasing by a greater absolute amount than ave is increasing. Conversely, it increases as soon as the increase in ave is greater than the decline in afe. These relationships hold true for
any firm having appreciable variable costs. Finally, marginal cost (MC),
the first derivative of total cost, declines as long as total output
is increasing at an increasing rate and increases as soon as total output
begins to increase at a decreasing rate. The MC represents the increment
to total costs as a unit of output is added. Thus if the AOC is falling
the MC must lie below it; if the AOC slopes upward the MC must lie above
it. These two curves are necessarily equal at the minimum point of the
AOC. Similarly, these same relationships exist between the AVO and
the MC.

The nature of the costs as set out above, along with the nature of
the demand curve facing the individual firm, automatically determine the
optimum output in the short-run. Under competitive conditions marginal
revenue, the addition to total revenue attributable to a unit increase in
sales, is identical with selling price. Profits are maximized when
output is such that marginal cost equals marginal revenue. Consequently,
the size of the firm in the short-run and as measured by units of output
is established by the equation of selling price and marginal cost.

A review of literature readily indicates that the size of the firm
is more generally envisioned in terms of input of the factor considered
as fixed in the short-run. The foregoing discussion of the scale of
output in the short-run is one measure of size — yet it is only indirectly

1If selling price is below the minimum AOC but above the minimum AVO the firm can minimize losses in the same manner. If selling price is below the minimum AVO the firm can minimize losses by ceasing production.
Figure 1. Short-run cost curves.
related to size as measured by the fixed factor. Nevertheless it is a
near-indispensable step in developing long-run trends in the size of the
firm.

The optimum output in the short-run is not necessarily coincident
with that of the long-run. The two never coincide under situations in
which selling price is either above or below the firm's minimum atc. In
case the selling price is equal to the minimum atc, the optimum output
for the short-run may or may not be identical with that of the long-run
as is brought out in the paragraphs immediately following.¹

Size of the firm in the long-run. The distinction between fixed
and variable factors tends to disappear if a sufficiently long period
of production is taken into consideration. Actually, the long-run is
defined as a period in which it is possible to vary the factors con-
sidered as fixed in the short-run.² This distinction serves as a
useful device in the final consideration of the size of the firm under
static conditions.

A long-run average total cost curve (ATC) can be drawn as the amount
of fixed factors varies with output. This curve is also U-shaped but
for reasons different than those for the short-run atc. The downward
slope in early ranges of output is due to economies of large scale.
These economies may be classified as technological and pecuniary and

¹Whether or not it is the long-run equilibrium depends upon the size
of the plant for which atc and selling price are equal.

²The distinction between long-run and short-run is only one of degree.
may be either internal or external to the individual firm.

Pecuniary internal economies are represented by such advantages as lower prices for materials purchased in large lots. Pecuniary external economies consist of the same type of saving which accrues to the firm because it is part of a large industry. Technological internal economies are represented by savings such as those which result from the full utilization of expensive machines; as output is increased more and more indivisibilities are overcome and either the efficiency of the factors already employed increases or more efficient factors are employed whose employment was not remunerative for smaller outputs. Technological external economies are rare but are represented by the gain accruing to a pioneer farmer as neighboring farmers settle the land, kill the wild beasts and thus lessen crop damage.

Given the state of technology, a point must be reached where all economies are realized and as the size of the firm is expanded even farther it runs into the range in which ATC increases due to the diseconomies of large scale production. These diseconomies can be categorized into the same groups as for economies of large scale.

There is a distinct relationship between the short-run average total cost (ata) and the long-run average total cost (ATC). The firm's ate is the envelope of the family of short-run curves (ata₁,₂, ..., n), each of which represents the ideal combination of resources for that scale of plant. Each of the short-run ate's is tangent to the long-run ATC. The ATC is a smooth curve since the number of size of plants is
assumed to be infinite. The point of tangency falls either to the
right or left of the minimum point on all ate's except one. There is
one short-run curve which will be tangent to the long-run curve at the
minimum point on both. As is indicated in Figure 2 a given output
may be produced by plants of various size. In general, the same output
will have different costs depending on the size of the short-run plant.
Figure 2 illustrates this point clearly. An output of \(OQ_1\) could be
produced at a unit cost of \(OC_3\) by the firm of size indicated by \(ate_1\).
It could be produced at a unit cost of \(OC_4\) by a firm of the size
indicated by \(ate_2\). This relatively small output could be produced at
a lower cost per unit by the small firm due mainly to the lower total
fixed cost. On the other hand, an output of \(OQ_2\) units could be produced
at a lower per unit cost by a firm of the size indicated by \(ate_2\) than by
\(ate_1\). This is due to the economies of large scale production as outlined
above. Obviously, there is an optimum-sized plant for any given output.

According to the accepted analysis, the size of the firm in the
long-run and under competitive conditions must be such that the short-run
average total cost curve is the one tangential to the long-run average
total cost at the minimum point of the latter (\(ate_2\) in Figure 2). The
output of the firm of the size indicated will be that which gives the
lowest total cost per unit (\(OQ_3\) in Figure 3).

That the firm be of optimum size in the long-run is a necessity
under competitive conditions. Otherwise it cannot survive. For example,
compare firms of three different sizes as expressed by \(ate_1\), \(ate_2\), and
\(ate_3\) in Figure 3. The selling price confronting each individual
Figure 2. Relationship between long-run and short-run cost curves.

Figure 3. Long-run equilibrium and size of the firm.
firm at the outset is OP\textsubscript{1}. All three firms are realizing pure profits. New firms attracted by these profits will enter the field, increase supply and thereby lower the market price. Entry of new firms will continue until no pure profits exist in the industry. Non-existence of pure profits is possible only when selling price is equal to the minimum ATC. If the selling price is any higher, firms both smaller or larger than that indicated by ato\textsubscript{2} can exist. However, once a price equal to the minimum ATC (OP\textsubscript{2} in Figure 3) has been established a firm either larger or smaller than that represented by ato\textsubscript{2} will realize a net loss. Accordingly, all firms will adjust to this size or be forced out of the industry. The long-run equilibrium is thus established by a market price of OP\textsubscript{2} and a firm size of ato\textsubscript{2}.\textsuperscript{1} This is a firm of optimum size in terms of returns to the business and in terms of the combination of fixed and variable factors.

**Dynamic economics and size of firm**

The analytic tools developed by the static theory of production are useful as tools but are far less realistic than those of the non-static theory of production. This is as true in the consideration of the size of the firm as in other sectors of economic theory. An important part of the spade-work in the theory of the firm under dynamic conditions has been developed by Kaldor (44) and is especially relevant in the

\textsuperscript{1}This same type of long-run adjustment would also come about were a price of less than OP\textsubscript{2} to be taken as the short-run starting point.
discussion of firm size. Apropos, Kaldor's analysis parts company with that of static theory at the minimum point of the firm's long-run average total cost curve as is outlined below.

One requirement for the preservation of pure competition in an industry is that the firm's average total cost curve must slope upward after a certain amount is produced. This produces no conflict between the static and non-static theories for short-run considerations. By definition, some factors are fixed in the short-run and costs must eventually rise due to diminishing returns. Too, both theories agree that as the scale of operations is increased in the long-run, the cost per unit must fall within certain ranges of output. Again, this is due largely to internal economies as the indivisibility of certain factors is overcome and/or as productive agents are purchased at lower prices. Under a given state of technology a point must be reached where all technical and pecuniary economies are realized and costs thus reach a minimum. However, it is here where the two theories part company. The dynamic theory indicates that costs may at first rise beyond this point as additional units of indivisible factors are added, but afterwards they must again fall to the same minimum level as before since the indivisibilities are again overcome. Indivisibilities thus cannot explain the limitation upon the size of the firm as long as all factors are freely variable and prices are constant. External diseconomies explain only why the costs of the industry rise and not why the costs of the individual firm rise relative to those of the industry. Any diseconomies which limit the size of the firm must be internal to the firm.
Role of management. A knowledge of the prices of the factors of production and of the production function (excluding management) does not explain the optimum size of the firm, but only the optimum combination of these factors. Therefore, in order to determine the optimum size of the combination, the postulate is necessary that there is at least one fixed factor of production. The determination of the optimum size of the firm is then possible as a result of the principle of diminishing returns. However, it is necessary that the factor whose supply is fixed for the firm must be variable for the industry. Otherwise the industry would have to consist of one firm or at least a fixed number of firms. Accordingly, the fixity of supply must arise not from a market limitation of supply but because of a limitation peculiar to each firm. This means that there must be a factor of which the firm cannot have two units simply because only one unit can perform the requisite duties.

Only one factor of production can possibly meet the necessary conditions of fixity. This factor is management. But what characteristics of management meet the conditions of fixity?

Management is variously defined as consisting of two things: (1) supervision, and (2) coordination. The first of these, supervision, is not the limiting factor. If the optimum combination is, for example, one foreman to fifty workmen it may not pay to hire an additional foreman for twenty-five additional workers. Yet if fifty additional workmen and one foreman are taken on, the indivisibilities are overcome and the output should be twice as great (as long as the supervisors of equal ability are available).
This same type of reasoning does not hold true for the coordinating or decision-making factor. The supply of this form of management cannot be increased along with all other factors of production. This is true since each decision must be weighed against all others in the head of the ultimate manager or managers. Even though the ultimate management be represented by several persons, such as a board of directors, the addition of one more member does not eliminate the necessity that original members still weigh all alternatives. The firm's long-run cost curve and thus its optimum size is determined by the finity of the decision-making factor. Decision-making, the ultimate fixed factor, again brings into play the principle of diminishing returns.

Decision making is a dynamic function. It is required only because there is change. Were there no economic change, plans could be carried out day after day according to the original decision. New decisions, and management in this respect, would not be necessary once the optimum plan had been adopted. Too, lack of economic change makes the optimum size of firm indeterminate. The size of the firm could be increased indefinitely in multiples of that existing at the minimum cost point and which is attained when all economies of large scale have been realized (costs would remain at the same minimum for the various ranges of size).

Although a fixed factor, decision making need not be indivisible. The amount of this factor attached to one firm cannot be increased yet there is no reason why this unit of fixed factor cannot be combined with less and less of other factors at increasing returns to the latter. Or in other words, the amount of other factors cannot be increased indefinitely with undiminished efficiency of the fixed factor. It is for this reason
that the firm's costs must eventually increase.

The optimum size of firm is thus established as limited by the decision-making factor and is dependent upon the nature and degree of economic change. The size of the firm may be expected to remain relatively small during a period of rapid change and important decision making.\(^1\) It will expand in periods of little economic change according to the Kalder (44) analysis.

One additional consideration of dynamics and the size of the firm is in order. It is now necessary to give greater consideration to the manner in which the firm meets uncertainties and the consequence of these actions on the size of the firm.

The static theory makes no distinction between present and future commodity prices or factor costs. Since the theory does not envision change, present and future values can be treated as identical. An equilibrium is thus determinate. Once the concept of perfect knowledge of the future is abandoned, however, anticipations assume an important role. The firm can no longer expect that the optimum output of the present, based on equation of actual marginal costs and marginal revenue, will also be that of the future. The "data" upon which the operations are based must take into account anticipated future costs and prices as well as those of the present. This does not require complete abandonment

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\(^1\)This is somewhat incompatible with the business cycle analysis of Schumpeter (66). According to his analysis a period of change will result in pure profits and thus encourage business expansion. Actually the two ideas may not be inconsistent in all aspects. For example, the revival stage of the business cycle may be looked upon as a period of change but it may be accompanied by less uncertainty, thereby easing the complexity of decision making.
of the traditional concept of equilibrium.

The analysis can now be divided into two parts: (1) when there is certainty as to anticipations, and (2) when there is uncertainty as to expectations. The first case anticipations are single-valued. The entrepreneur thinks that he knows exactly what will happen in the future.

For single-valued expectations the determination of the optimum plan and scale of operations is relatively simple. The optimum scale is simply represented by that plan which promises the maximum present discounted values of anticipated net receipts. Scale of operations will be determined as the discounted marginal cost is equated with the discounted marginal revenue and as the most promising of all alternatives is adopted. The anticipation of either higher prices, lower costs or increased physical productivity will favor expansion of output over that of the present. The converse is true in case lower prices, higher costs or lower productivity are anticipated.

Additional concepts. The assumption of single-valued anticipations is one step in the direction of reality. The second step is the case in which entrepreneurs' estimates for the future are regarded as uncertain. In the latter case a guess may be made as to the general level of future cost or prices but the firm will not have perfect confidence in its estimate. Both risk and uncertainty as defined by Tinctor (74) may be involved.¹

¹According to these definitions risk exists when only one probability distribution is involved. This single probability distribution may, for example, be that of future prices or costs. The firm thinks that it is certain as to the type of probability distribution although it may not be certain as to the true value within the distribution. Uncertainty involves two probability distributions. The firm must decide on the most probable of several probability distributions of costs or prices.
According to the analysis of Hart (29) the introduction of uncertainty requires new concepts not recognized under the static theory of production:

1. Expectation schedule: The firm is supposed to have an expectation schedule for prices and costs at each future date. These expectation schedules may well differ between firms. Neither are they necessarily the most probable price. The expectation for each firm is that which it sees as most likely in light of the information it possesses.

2. Dispersion: The firm is supposed to recognize the possibility of various prices and costs higher or lower than the expectation. A probability is supposedly assigned each and the estimates of the near future will show less dispersion than those for later dates.

3. Anticipation of convergence: The firm can expect that the range of its estimates for a given date will narrow as the date approaches. These new concepts introduced by uncertainty will obviously have far-reaching effects on the size of the firm. A difference in expectation schedules or rate of discounting the future may explain the difference in the size of two firms even though they produce the same product, employ the same technology and both have unlimited resources at their command.

The size of the firm at any given date may deviate rather widely from the size of firm which might be considered as optimum in light of the cost/price relationships then existing. This is understandable since the size of the firm at the time \( t_1 \) is based on the anticipation of an earlier time, \( t_0 \). The divergence between the optimum size of firm and the size of firm actually existing at any given time will tend to vary directly with the
degree of uncertainty which exists in the economy.¹ Moreover, the probability is that the actual size of the firm will fall short of the optimum size the greater the degree of uncertainty. It is entirely possible, however, that the firm's anticipations will lead to a firm of greater than optimum size.

The strategem with which the firm avails itself in meeting uncertainty may also affect its size. Since the firm expects the range of possible prices (or costs) for any given time to converge as that time approaches and before all decisions affecting input and output have been made, it is expedient that it retain flexibility in plans whenever possible.

By flexibility in plans is meant the postponement of decisions until further information may be available. The retention of flexibility as a means of meeting uncertainty is especially applicable in the case of a commodity for which the production is continuous in time and in which adjustments in scale of operations can be made gradually. For a commodity in which the production is discontinuous the entrepreneur will have to make all his decisions as to volume on the basis of information which is available at the present. This inability to act upon additional information as it becomes available naturally results in a greater divergence between actual volume and optimum volume at any given time. Again, the greater the uncertainty and the downward revision of expectation prices (or costs) the greater the probability that actual volume will fall short of the

¹This has a different connotation than N. Kaldor's analysis. In this case uncertainty is used to explain the reason why the actual and optimum size of firm may differ. In the Kaldor analysis uncertainty is used to explain why the optimum size of the firm is limited.
optimum volume at the time that the discontinuous production period is consummated. These tendencies may be further accentuated in case large layouts in fixed costs are involved. It will pay to avoid or postpone commitments in fixed capital (which must remain idle or operate at a loss in case prices or costs prove unfavorable) even though such would be profitable under today's cost and price expectation but if the dispersion is expected to be less in the future.

The firm may also handle uncertainty in the manner suggested by Stigler (69). A firm certain to produce exactly $X$ units in the future will adopt the short-run plant which will produce this quantity at the lowest cost. This firm will be able to produce exactly $X$ units at a lower cost than will a firm designed to be passably efficient for any output from $X/2$ to $2X$ units. On the other hand a production of $X/3$ or $2X$ units in the first mentioned plant may come at a higher cost than for the last mentioned plant. This difference in cost relationships depends upon the flexibility and divisibility built in the plant. Thus if fluctuations in costs or prices are anticipated the firm will adopt the flexible unit which may necessitate a greater fixed plant.

It may be concluded that dynamics has much to do with the theoretical size of the firm. The principles as outlined above explain not only why a limitation to the optimum size of the firm exists but also why the actual size of the firm at any one time may deviate from the optimum. Further, they suggest (1) why the size of any two or more firms may be different even though their production situations be identical, or (2) why the size may be identical even though their production situations be dissimilar.
Both could result from different expectations as to future prices and costs. If two firms of identical production situations at a given time $t_0$ expect different prices (or costs) at a future time $t_1$, the output of the firms may well differ when the time $t_1$ arrives. Conversely, if at the time $t_0$ firm $A$ with high average and marginal costs expects a higher price (or lower costs) at a future time $t_1$ than firm $B$ with lower marginal and average costs, the output of the two firms may be identical at the time $t_1$ even though their cost situations be different.

**Adjustments in the size of the firm**

Changes in the size of the firm might be explained in terms of either the short-run or the long-run. Short-run adjustments have been left out in the following discussion of changing size since it is the long-run adjustment which is pertinent in this study.

**Adjustments under static conditions.** The theory of size adjustment under static conditions is easily explained. The adjustment must be caused by a change in the firm's cost situation. Such cost modifications

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1. This is actually the semi-dynamic adjustment of Marshall (48). In a pure static state no change would take place. This case has been termed "static" to differentiate it from the more complex dynamic change outlined in following paragraphs.

2. Changes in the firm's price situation in the absence of any change in the cost situation will bring forth adjustments in output. These adjustments in output, however, are only of a short-run nature if the firm's cost curve does not change and if competition exists. It may be true that a change in price will also be the cause of a long-run change in costs. For example, if a large increase in price were to some extent about the number of firms in the industry (or the size of firms already existing) might increase by much. This expansion in the
may come about through a change in factor prices, a change in techniques or both.¹ An increase in the price of the variable factor while the price of the fixed factor remains constant (or if both increase, a greater relative increase for the variable factor) will move the minimum point on the firm's average total cost to the left. Accordingly, the firm's new long-run equilibrium will come at a smaller output than before the increase in variable costs. The size of the firm will have decreased since under competition all firms must adjust to the optimum size in terms of costs or suffer a net loss. A decrease in variable costs relative to fixed costs will have the opposite effect; size in terms of output will be increased.

An increase in the price of the fixed factor, with that of the variable factor remaining constant (or if both increase, a greater relative

(amount of productive resources and the competition with other industries may in turn bid up the price of productive factors. Accordingly, any such change in the cost situation for the individual firm will change the point of minimum costs and hence may change the long-run size of the firm. If the expansion of the industry brought about an increase in the relative cost of the variable factor the low cost point would be shifted to the left and firms would, at the new long-run equilibrium, produce a smaller output than before the change in commodity prices and hence the change in factor costs. The revenue will be true in case fixed costs are increased relative to variable costs.

¹A change in techniques is usually equivalent to a change in the relative prices of the factors.
increase for the fixed factor), will move the low cost point to the right.\textsuperscript{1}

The firm's long-run equilibrium will now come at a greater output.

Competition will again bring this about. A decrease in the price of the fixed factor will have an opposite effect.

A change in the techniques of production may have the effect of changing the relative prices of fixed and variable factors. For example, an increased productivity of the variable factor will be equivalent to a decrease in the price of this factor under constant techniques. The long-run equilibrium will come at a greater output. Some changes in techniques will change the nature of the firm's long-run equilibrium altogether. This is especially true where a fixed factor is substituted for a variable factor. Certainly the new low cost combination will come at a greater output if the change and increase in fixed costs is great and/or if variable costs are decreased.

\textit{Adjustments under dynamic conditions.} Adjustments under non-static conditions will parallel those of the static where no change in uncertainties come about. Should either changes in factor prices or the change in techniques introduce more or less uncertainty, the relative adjustment will be somewhat different. If the change is one encouraging expansion in terms of costs and if uncertainties are lessened, the relative

\textsuperscript{1}If average fixed costs represent a relatively unimportant fraction of the average total cost both before and after the increase in the price of the fixed factor, the point of lowest average total cost may remain at the same output. The same qualification is true for changes in the price of the variable factor when variable costs constitute an unimportant part of total costs.
expansion will be greater than if the previous degree of uncertainty were retained. If the change is one encouraging contraction in terms of costs and is accompanied by less uncertainty, the contraction will be less than if the previous degree of uncertainty were retained. This follows from the entrepreneur's discount of the future.

Changes in costs encouraging an expansion but accompanied by greater uncertainty will result in a smaller actual increase than if the degree of uncertainty had remained constant. A cost situation encouraging contraction but resulting in greater uncertainty will encourage a greater actual contraction in output than if uncertainty remained constant.

Furthermore, an increase or diminution of uncertainty with costs or techniques remaining constant may alone cause a size decrease or increase respectively. It is also true that the relative adjustments of individual firms will vary by much depending upon the degree of uncertainty envisioned from a change in costs or techniques. Even though original costs were the same for two firms the adjustment to a new and identical cost situation will not be the same if the two firms discount the future at different rates.

Forces Conditioning Farm Size Adjustments

Any attempt to apply the farm size predictions and their implied static analysis to developments over the past twenty years is doomed to disappointment. This conclusion is obvious once farm size changes are examined.
If mechanization were the major force motivating change and if adjustments took place in the manner suggested in the theory of the firm, farm size adjustments should have been greatest in such areas as the small grain and corn areas. It is here that mechanization has been most nearly applicable. Conversely, it should be the cotton, dairy, range and similar areas in which the change has been least since fewer labor-saving machines have been developed for or adopted in these areas. Table 1 indicates otherwise. The average size of farms in four Nebraska range counties increased by 78.0 per cent from 1920 to 1940 whereas the increase was only 11.4 per cent in six Kansas wheat counties. The size of farms increased by 33.1 per cent in six Mississippi cotton counties while the increase was only 3.4 per cent in four Iowa cash grain counties. Obviously the cost advantages which result from mechanization and which favor the large unit have been greater in the case of wheat than in the case of range cattle production or for corn as compared to cotton. Mechanical developments favored the dairy producer as much as the cotton producer in the 1920-40 period but no such great increase in farm size came about.

It thus seems necessary to look beyond mechanical developments and the static theory of the firm in order to explain the major adjustments in farm size. The dynamic theory of the firm as outlined on the preceding pages is one step nearer reality. Were the economic environment of the firm in agriculture exactly as that set out in the theory of the firm, then farm size adjustments identical with those suggested by the foregoing analysis might have come about. However, not even the postulates of the
Table 1. Change in average acreage per farm by specified counties and farm types. 1920-1940.

<table>
<thead>
<tr>
<th>Area and farm type</th>
<th>Average number of acres per farm</th>
<th>Increase 1920 to 1940</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1920</td>
<td>1940</td>
</tr>
<tr>
<td>Six Kansas wheat counties</td>
<td>244.6</td>
<td>272.5</td>
</tr>
<tr>
<td>Four Nebraska range counties</td>
<td>1846.6</td>
<td>2179.5</td>
</tr>
<tr>
<td>Four Iowa corn grain counties</td>
<td>171.0</td>
<td>178.5</td>
</tr>
<tr>
<td>Six Mississippi cotton counties</td>
<td>54.1</td>
<td>45.4</td>
</tr>
<tr>
<td>Six New York dairy counties</td>
<td>118.3</td>
<td>123.5</td>
</tr>
</tbody>
</table>

*These figures are based on census data (80) and for that reason the averages shown include a type of error brought out in section III of this study. However, an examination of farms by size distributions indicates that the relative changes between areas tend to be as suggested in this table.

b Clay, Dickinson, Harper, McPherson, Pratt and Stafford.

c Cherry, Grant, Hooper and Thomas.

d Hamilton, Humboldt, Webster and Wright.

e Coahoma, De Flore, Humphreys, Sunflower, Tallahatchie and Yazoo.

f Chemung, Delaware, Herkimer, Madison, Oneida and Orange.
dynamic theory previously outlined fully account for the situations
peculiar to agriculture. Chief among the several special circumstances
in agriculture is the imperfection in the market for factors of production.
The typical firm in agriculture simply does not have access to unlimited
resources; nor is the supply of factors continuous. For that reason
two of the traditional assumptions in the theory of the firm, (1) that
each firm is able to equate marginal costs and marginal revenue, and
(2) that each firm will adopt the optimum scale of operations, must be
partially disregarded as keys to size adjustments.

This section represents an attempt to give the subjects of changes
in farm size and the determination of farm size a more realistic
explanation than has been found true in the unqualified theory of the
firm or in the predictions of farm size changes. It is not an attempt
to refute the theory of the firm. Actually the theory of the firm is
embodied in this analysis to the extent allowed by the traditional
postulates. Neither does the analysis preclude certain of the tenets
contained in past predictions of farm size change. It does not preclude
the possibility that some farms are able to operate at an optimum scale
such that marginal costs or marginal revenue are equal or that adjust­
ments are made to the new optimum whenever price/cost relationships
change. It does not preclude the fact that although some operators
may not operate at the optimum due to lack of capital they will adjust
in the direction of any new optimum although they do not have the capital
to go the full way.
The analysis is mainly directed at showing that mechanization and lower costs for the large farm does not have to force liquidation of the small unit as is often supposed and that there are also other important forces conditioning farm size adjustments. It is concerned not so much with the few farmers who are able to attain the optimum scale of operations suggested in the theory of the firm as with the greater number who are never able to push to a point such that marginal costs and revenue (or their discounted values) are equal.\(^1\)

**Stimuli to farm size changes**

The analysis of this section rests more on the truism that an income great enough to meet commitments or to compare favorably with other alternatives is a greater force in farm size adjustments than is the customary firm analysis wherein profits are maximized and the optimum scale of operations is attained.\(^2\) This detour from the classical firm model is made not because the theory of the firm within the traditional

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\(^1\)The analysis is not concerned with changes in farm size which result from shifts in type of farming. It is true that mechanization or other forces may bring about shifts in type of farming and that farm size may thus change from the shift in type of farming alone. However, this is only a special case and need not be discussed apart from the general analysis.

\(^2\)Comparative returns enter into total expenses as an opportunity cost. However, even the inclusion of opportunity costs does not account for the fact that the farm operates at a scale such that marginal costs and revenue are not equated or that the optimum scale of plant is not attained.
postulates lacks logic but because the postulates themselves are unrealistic when applied to agriculture. The heterogeneity of farm size within groups homogeneous as to production conditions and where the managerial ability of the operator does not differ greatly is obvious proof that some individuals either do not or cannot adjust to the optimum-sized firm.

Some might question the potency of "comparative" or "necessary" income as forces in the abandonment of farms in the expansion of operations. Common sense, however, indicates that the individual will be more concerned with expanding operations if such promises to fill a gap of 400, 700 or 1000 dollars in meeting interest payments or customary family living expense and which has been occasioned by certain changes than he will be in dreaming about an optimum-sized unit to which he can not expand. Or, he is more likely to abandon his operations in favor of other alternatives if such promises to reward him by 500, 1,000 or 1,500 dollars annually than he is to abandon the occupation when his net income compares favorably with other alternatives but is less than for a farm of optimum size which he can not attain.1

Even if common sense cannot be trusted, there is ample evidence to support the above contention. Several recent examples are worthy

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1It is probably true that a farm operator will stick to his farming operations even though the returns be somewhat less than what might be realized as a laborer. Yet this is only a matter of degree and does not invalidate the statement made.
of mention. The number of farms in sixteen South Dakota counties\(^1\) dropped by 31 per cent from 1930 to 1940 while the average size of farm increased by 75 per cent. The diversity of farm size previous to 1930 would indicate that not all farms were of optimum size. Yet the alternatives to remaining on the farm, dark as they were during the 1930's, were more effective in bringing about adjustments in farm size for these counties than were the potentialities of an optimum-sized unit or mechanisation previous to 1930. The migration from farms which started especially in 1941 further illustrates the potency of the income force. About 940 thousand persons moved from farms in 1941 as compared to 231 thousand in 1940 (79). Only a small percentage of these went into the armed services. The motivating force was the number of more attractive opportunities elsewhere.

"Comparative" income has a special bearing on the size of the firm in agriculture. The spatial factor limits the number of firms which can exist at any one time. Thus some firms can expand acreage only if other operators forsake the industry for alternative occupations.

**Mechanisation and changes in farm size**

As has already been suggested those who predict very large increases in the size of farms as a result of mechanisation reason in the following

\(^1\)As shown by the United States census for the counties of Bennet, Carson, Fall River, Haaken, Jackson, Jones, Lyman, Maltese, Perkins, Stanley, Sully, Todd, Tripp, Washabaugh, Washington and Zieback.
The use of labor-saving machinery results in a high fixed cost. This high fixed cost gives an advantage to the large-scale producer who is able to substitute the new technique for the old. He is able to produce at a lower cost, has a greater income than before and thus will drive out the small producer whose unit is too small to merit the use of the new machinery. That mechanization has had some important effects on farm size is obvious. Yet the outcome outlined above over-emphasizes the case. This outcome is a possibility but is not a necessity when "comparative" or "necessary" income rather than a maximization of profits for a firm of optimum scale is considered as the key to adjustment. The outcome depends not only on what happens to costs (whether costs are lowered and the low cost point is shoved to the right) but also upon certain other forces. Such forces include the availability of additional lands and the nature of farm tenure. The outcome will vary depending on the combination of these forces.

**Available land.** The first combination of forces which can be considered includes (1) a mechanical invention which results in a cost advantage for large units, (2) the availability of additional land which can be brought under cultivation, and (3) varying forms of tenure. In order to simplify the discussion it will be assumed that adoption of the new technique does not pay unless the scale of operations is above "average" in size.

The mere fact that mechanization makes possible lower costs on the farm greater than "average" in size should encourage some such farms to adopt the new technique even though they do not change their acreage.
As long as this is the only development (adoption of mechanization by some large farms but with no change in total acreage) the net income of the operator on a farm of "average" size or less will not have changed. The price he receives for the commodity and his gross income will not have changed. Neither will his costs have changed since it does not pay to adopt the new technique on the farm of "average" size or less.

If he were to maintain his current scale of operations while adopting the new technique he would diminish net returns. Further, even if some farms do consolidate, the operator on the farm of "average" size or less will not be forced to expand as long as the total acreage of the commodity does not increase.

But suppose the new technique lowers costs by enough to encourage a greater acreage of the crop. This greater acreage may come about either through a shift of land from other crops or through the cultivation of land not formerly cropped. It is then that mechanization will have far-reaching effects on farm size. The greater acreage and production of the crop, where additional land is available, will mean a lower price for the commodity and a lower gross income from a given acreage of the crop. An individual will now be as well off as before the innovation and consequent increase in acreage only if his absolute decrease in gross income is offset by a decrease in costs. Some operators may offset this decline in gross income through a decrease in costs brought about by the adoption of the machine even though they do not expand scale of operations. However, in order that this be possible
the farm must be greater than "average" in size. Otherwise it would not pay to adopt the new machine without increasing acreage. Of course operators who were previously able to and did operate at the point of optimum returns may be expected to adjust to the new optimum.

The tendency will be of a different nature for the farm which is of "average" size or less. It cannot offset the decline in commodity price through the adoption of the new technique while maintaining the same scale of operations. This type of adjustment would have the effect of augmenting the reduction in net income. In order to have an income as great as before the change in mechanization and hence the increase in the total production of the crop, this operator, if he is to remain in farming, must now adopt the machine and expand his operations. He, of course, has another alternative: He can leave farming and turn to another occupation. If the supply of land which can be converted into farms is limited the latter will be necessary on the part of some operators before others are to be able to expand operations.

The operators of both tenant and owned farms of "average" size or less will be affected. The underlying cause of the adjustment, however, will be somewhat different in the two cases. The impact of the lower commodity price should theoretically come to rest on the land. This production factor should now be able to command less in the form of rent because of its inelasticity of supply relative to other factors. The play of competitive forces should thus return the tenant operator as much for his labor and capital as before.
As long as this is true the tenant operator on a farm of "average" size or less will not be forced to expand from a "customary" or "necessary" income standpoint. However, any move by some operators to rent additional land may eventually cause this tenant farmer to either expand operations or leave the industry. Whereas the initial effect of the lower commodity price was to lessen the marginal product (in monetary terms) of land and leave the shares of other factors at the same level, the adoption of mechanization and expansion of operations by certain operators will lower their costs and restore the bargaining position of land. The tenant on the farm of "average" size or less will then realize a lower net income if he retains the same scale and technique. Costs will remain the same while rents will tend towards the former level.

A hypothetical example can be cited to illustrate these tendencies. A tenant operator has been producing a crop which grossed $30 per acre and for which costs have been $10 per acre. The competitive cash rent which he has paid per acre amounted to $10. This left a net return to other factors of $10 per acre. Now the mechanical development occurs, total acreage is expanded, price drops by 10 per cent and the gross income falls to $27 per acre. As long as there is no wholesale competition for additional land the rent of land should likewise fall by $3 per acre leaving net returns for the tenant operator on the farm of "average" size or less at the previous level. But now suppose that some operators who have adopted mechanization expand operations and by so doing lower production costs by $3 per acre. Perhaps $2 of this reduction may be claimed as rent by land, the factor for which the supply is least elastic. The tenant will now find that rents have gone back to $9 per
aore while gross returns are only $27 and other costs are still $10 per acre. This leaves a net of only $8 for the tenant of the farm of "average" size or less who has retained the same scale and technique. Yet if he were to adopt the new technique and retain the same scale net returns would be diminished even more. If net income is to be kept at the former level, the tenant operator of the small unit will also be forced to adopt the new technique and expand operations. Or, he may turn to other occupations thus paving the way for expansion by others.

The nature of size adjustments for farms of "average" size or less will be almost identical in the long-run for tenant and owner-operated farms. On the other hand the short-run tendency on the owner farm will be different from that already outlined for the tenant farm. The effect of mechanization, greater production and lower commodity prices was, at the outset, to diminish rents and leave the returns for the tenant's capital, labor and management at the previous level. Thus his net income also remained at the previous level since it is made up entirely of the marginal product of capital, labor and management. This is not true for the owner since rent is also part of his net income. Mechanization, increased production and lower prices should have the effect of forcing the owner operator into immediate expansion of operations. The only manner in which he can now realize as great an income as before if he is to remain in farming is to adopt the new technique and expand operations.1

1He, too, may abandon farming in favor of other alternatives. This, again, is necessary on the part of some if others are able to expand.
This owner-operator on the unit of "average" size or less must also maintain operations at a greater scale in the long-run. The fact that some persons adopt the new technique, lower costs and are thus able to bid more rent on the land does not alone augment his income. His net returns will remain at the lower level as long as he retains the same scale of operations and same technique. Costs will be the same but gross income will be less than before. Income can be maintained only if the new technique is adopted and operations are extended.

Lack of available land. A second combination of forces which can be considered includes (1) mechanization, (2) lack of additional land which can be brought under cultivation or shifted from other crops, and (3) varying forms of tenure. Again it may be assumed for purposes of analysis that it does not pay to adopt the new labor-saving machine on farms of "average" size or less.

The mere adoption of the new device by a few operators will not necessarily force any small scale operators into expansion from a "customary" or "necessary" standpoint. As long as no other forces are under way the small-scale operator will still have as great a net income as before the invention of the machine. Once a move to expand has started, however, a definite pattern of farm size change may develop depending upon the nature of tenure. If any appreciable number of farms had been able to

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1This combination might include mechanization and a complete lack of additional land for the crop in question or mechanization and only an insignificant increase in acreage of the crop.
operate the optimum size unit before the innovation they may now find that
the optimum size requires operations on a larger scale and adjust accord-
ingly. But even though this type of expansion takes place by some farms,
the small-scale owner-operated farm will not be forced to expand from
the "customary" or "necessary" income standpoint. The fact that no
additional land (or only an insignificant amount) can be brought into
cultivation will leave the price for the given commodity and the gross
income to the industry at the previous level. Likewise the gross income
for the individual operator will remain at the same level if his previous
scale of operations is maintained. His net income will also remain at
the previous level since neither costs nor gross income will have changed.
Now if the farm is one of "average" size or less and was unable or had no
incentive to expand before the advent of the new machine, there should
be little tendency to expand after the innovation. Certainly it could
not be said that the operator will be forced into expansion. True, the
potentiality of adopting the machine, expanding acreage and increasing
net income exists. However, the possibility of expanding scale and
augmenting income existed before the development of the new machine.

It may be true that where adoption of the new method is warranted,
the cost of production will be lowered and the saving will be capitalized
into the value of land. This will have no direct income effect on the
small-scale operator who continues to operate under the old technique
and at the same scale. He will not be forced into expansion and his
The operation of the airship itself is determined by the laws of
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may now expand to the new optimum), and (2) the supply of land is relatively inelastic as compared to other factors in agriculture.

If rents are flexible the tenant on the farm of "average" size or less must now compete with the large-scale operator who can pay higher rents because of his lower costs. The small-scale tenant will have to pay the higher rents or relinquish his lease to the land. This means that his net income will be lower than before the innovation if he retains the current scale of operations (assuming gross income and all costs but rent remain at the same level). In order to bring his income back to the former level the tenant on the farm of "average" size or less must now adopt mechanization, expand operations and lower costs. He will have been forced to expand operations from the "customary" or "necessary" income standpoint.

If rents are not flexible, the tenant operator will be affected exactly like the owner operator. The lack of additional lands for cultivation of the crop will leave the gross income to the industry at the previous level. Due to the inflexibility of rents the tenant's costs will be no greater than before and his net income will remain at the previous level even though he does not expand operations. He will thus not be forced into expansion from the "customary" or "necessary" income standpoint.

Typical cases. Situations representative of the cases outlined can now be pointed out. Mechanization in combination with additional land brought under cultivation is represented by wheat production. Mechanization and a lack of additional land is represented by corn.
course, there have been numerous other forces serving to stimulate farm
size adjustments in the case of either commodity. These additional
forces will be pointed out in a later part of this section.

Mechanization and the consequent lower costs have had far-reaching
effects on the United States wheat producer. It has made possible the
use of land which was previously submarginal in the production of wheat.
It has thus encouraged a greater wheat acreage within the United States
and has also accentuated the trend toward a greater production in other
countries (Table 2).

Mechanization alone has had no such widespread effects on corn
production. The area in which the crop can be produced is more narrowly
limited by natural conditions than is true for wheat. Also mechanization
has resulted in no great shift of land from other crops to the production
of corn. World wheat production jumped by one-third between the periods
1900-09 and 1930-39 while corn production increased by only 11 per cent.
The increase in wheat production has likewise far exceeded that of barley
and oats, grains which serve as substitutes for corn.

Mechanization has exerted a greater pressure on the incomes of the
wheat producer than on that of the corn producer. As Shepherd (66)
indicates, the price of wheat in the United States has fallen relative
to the price of corn. Had there been no additional wheat land brought
into cultivation as a result of mechanisation the pressure of incomes on

---

1 The development of tractors has released some land from the production
of feed for horses. Too, hybrid corn has been an important develop-
ment in the industry. These two items represent a size-force to be
outlined in the next section. Even then hybrid corn is a fairly
recent development which would require qualifications only when its
full fury is felt in an economy lacking production controls and war-
stimulated prices.
Table 2. United States acreage and production and world production of corn and wheat by specified periodsa (millions)

<table>
<thead>
<tr>
<th>Period</th>
<th>United States acreage</th>
<th>United States production (bushels)</th>
<th>World production (bushels)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Corn</td>
<td>Wheat</td>
<td>Corn</td>
</tr>
<tr>
<td>1800-09</td>
<td>96</td>
<td>46</td>
<td>2615</td>
</tr>
<tr>
<td>1910-19</td>
<td>102</td>
<td>55</td>
<td>2656</td>
</tr>
<tr>
<td>1920-29</td>
<td>100</td>
<td>59</td>
<td>2695</td>
</tr>
<tr>
<td>1930-39</td>
<td>89b</td>
<td>56b</td>
<td>2309b</td>
</tr>
</tbody>
</table>

Source: Agricultural Statistics.\(^{31}\)

a. Excluding Russia and China.
b. Not exactly comparable to earlier periods because of acreage limitations.

size expansion would certainly not have been as great as has been experienced. True, corn farmers adopted mechanization and some expanded operations. Yet the rank and file producer was not forced to expand operations from an income standpoint to the extent that has held true for wheat producers.

The effect of other technological changes and outside economic forces

Mechanization represents only one form of technological improvement. It has increased the amount of work which can be performed per person.

Another type of technological advance has been equally important in agriculture. It is represented by such developments as higher yielding varieties, disease resistant strains, more efficient feeding methods and improved
in shape to produce at the commercial rate the necessary increase in price.  Improvements in temperature and climate, when climate does not decrease the crop, will be useful at that or in increased demand.  The third case where temperature change and an increased demand.

Demand and (e) an increase of demand

The commercial situation is thereby into the next case of

Directly upon the increase of demand, for the commercial

The effect of this type of commercial change on farm size hinges

be produced and imported

The direct participation in

are similar in that their effect on farm size in commercial temperamental will be to reduce the such forces within

in order to keep the commercial situation more manageable, the farm

comparative gains and similar factors among other changes suppose or demand.

Entirely in August, the decision of substance, the capital of

mented in August, the decision of substance, the capital of

be those of certain unobserved forces.  Such outcomes force

the effect on the improved commercial on farm size are partial

similar to that of import-export changes.

Whilst commercial and these other effects of change are

the improved commercial change to export some relationship to farm size.  The importance

though General Assorted in the discussion of this type of each.

not lessened the labor required per acre of

reduction per unit of in the stock product or crop produced.  They have

animal or per crop acre and with the data have not been in examined longer

insubstantial.  Such improvements have meant a greater yield per

60
will be more than proportional to the increased production. This type of improvement will not decrease total costs for the farmer. Total costs will remain the same, or more probably, will increase slightly. For example the advent of hybrid corn meant a higher price for seed and some additional cost in handling the greater yield. It is obvious that this technological improvement in conjunction with an inelastic demand must decrease the total net income for the commodity.

Farms which were operating at the optimum scale in terms of crop acres or animal numbers before the innovation will now find that the optimum unit so measured cannot possibly come at a greater scale than previously. Actually, an optimum unit, when measured by livestock numbers or crop acres, is most likely to come at a smaller scale than before the change. This certainly will be true since total costs per acre or animal will not have decreased.

How will this type of change affect the large numbers of farms which have long existed at a scale of less than optimum size? If rents truly reflect the marginal productivity of land the effect will be somewhat different in the case of tenants than in the case of full owners. The lower net returns should mainly come at the expense of land, the production factor for which the supply is relatively inelastic in agriculture. If rents are thus flexible downward the net income to the tenant farmer

---

1 The only case in which this would not be true is when an equally profitable alternative product exists and if the demand for such a product is not also inelastic.
should remain as great as before the innovation. The return for his labor, capital and management will compare as favorably with other alternatives or will come as near meeting fixed commitments as beforehand and there is no reason why the new situation should prove a stimulus to expanded operations for the tenant farmer.

This will not be true for the owned farm which was operated at a scale of less than optimum before adoption of the new technique. Regardless of the flexibility of land rents the net income of the owner operator will have suffered a reduction since the rent of the land is a constituent of his net income. In order that the returns to this group compare as favorably to other alternatives or come as near to meeting commitments as previously it will be necessary that their operations be expanded.¹

The two groups of farmers will be affected similarly when rents are not flexible. Such inflexibility often holds true in the case of share rents. The traditional share such as one-third, two-fifths and one-half tends to remain unchanged regardless of the economic situation and the share which is attributable to each production factor. The different economic situations are, however, somewhat reflected in the cash which is purportedly paid for the use of pasture, lots and buildings and which does vary from year to year. In case the rent is not flexible in the

¹This is possible only in case additional capital is forthcoming. The role played by capital rationing is discussed in a subsequent section. The fact that the farm was of less than optimum size suggests the possibility of using more labor and capital to augment income.
downward direction, the tenant will be affected exactly the same as the owner. His net income will have been decreased and in order to restore it to its former level he must expand operations or move into alternative lines of work.  

Technological change and an elastic demand. The second case which can be discussed is that of an elastic demand. It has no such strong influence on the tendency to increase farm size as does an inelastic demand.

The combination of technological improvement and an elastic demand will have the effect of increasing net returns for the commodity in question. If rents are flexible the tenant will pay a proportionally greater rent for the land and his net income will remain at the former level. If rents are inflexible such as may be true for crop-share leases the net income of the tenant will be augmented. In neither case will the tenant be forced to expand operations in order that returns compare as favorably with other alternatives or come as near meeting commitments as previously.

This combination of forces will certainly increase net returns for the owner operator. He will not be pressed into a greater scale of operations from the "comparative" or "necessary" income standpoint. Were the change severe enough it is possible that land values might increase

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1 An inelastic demand and a lack of close alternative enterprises would mean lower land values which in turn would make possible a larger unit with a given amount of capital. This would be meaningful, however, only to the person who had not previously invested in land but does so after the change.
sharply thus also diminishing the size of the unit which could be purchased with a given amount of capital.

**Other forces.** That the effect of a change in technology which increases output per acre or animal is similar to the effect of certain outside forces on farm size can now be clearly pointed out. Without further elucidation it is obvious that an inelastic demand in connection with an improved technology is equivalent in nature of effect to either an elastic or an inelastic demand in combination with any one of the following situations which lower the price of the commodity: (1) a reduction in tariffs which favors an inflow of foreign produced commodity, (2) the development of substitutes or (3) a decrease in demand for any reason whatsoever.

On the other hand the combination of an elastic demand and an improved technology can be likened in effect to any decrease in supply of competing commodities or any increase in demand for the given commodity. The combination of technological improvement and elastic demand will result in a greater income even as the price of the commodity is lowered since the increase in output will be more than proportional to the decline in price. The last mentioned forces will increase income through a higher price for the given commodity while output remains constant. Income will be affected similarly in the two cases.

The business cycle might be looked upon merely as a force affecting the supply of, or demand for, farm products and thus be included in the analysis just outlined. However, because of its peculiarities, the depression phase of the cycle merits individual attention as a factor
affecting farm size. If there is widespread unemployment elsewhere in
the economy and if the fall in farm income is merely proportional to the
decline in income elsewhere, the major effect of the depression is likely
to be that of holding operators on their farms while arresting any tend-
cy on the part of these operators to expand operations. The upward
tendency may be arrested by any one or combination of forces such as
greater uncertainty and lack of ability to acquire capital. On the other
hand, a decline in income for an area more than proportional to incomes
elsewhere will likely force some farm operators into other jobs (or
possibly to resort to relief) thus paving the way for remaining farms to
consolidate and expand operations in the hope of augmenting their dimin-
ished incomes. These tendencies are all noticeable in census data for
1930 and 1940.

The depression may have numerous other impacts on farm size. It may
result in many foreclosures and consolidations by lending agencies as is
suggested in studies such as that by Murray (23). It also results in a
move to small subsistence homesteads or part-time farming units as is
indicated by the increased number of such farms from 1930 to 1940; and
it may serve as the final impetus to a shift in type of farming and, in
turn, farm size. Furthermore, prices will probably fall at a faster rate
than costs thus penalizing large-scale operations. The latter is revealed

1This situation is exemplified by the South Dakota case cited earlier.

2To the extent allowed by the uncertainty and degree of capital ration-
ing which exists.
in farm business record data such as those in Iowa (37) and Minnesota (61).

Finally, any natural force which tends to lower the net farm income of an area relative to other alternatives will tend to result in a consolidation of farms. For example, a continued drought may be very effective. Likewise a continued state of soil erosion and depletion in an area will lower income and may force some operators from their farms thus opening the road to consolidation by others.

**Typical cases.** Two of the farm types mentioned earlier parallel the major cases outlined above. The case of cotton is analogous to that set of forces represented by "technological improvement and an inelastic demand".

Cotton has been affected by several forces of the "improved technology and inelastic demand" nature. Some improvement in yields has come about. Certain sections, especially the Piedmont areas of Georgia and Alabama, have suffered extremely from soil erosion. Bennett (8) indicates that from four to eighteen inches of top soil has been lost from 60-65 per cent of the region. This soil depletion and consequent lowering of incomes has been accompanied by a decrease of 50,000 farms and has thus allowed an expansion by others.

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1 This may appear incompatible to the earlier statement that some farms may expand. Such is not the case between areas. An examination of farm records and census data indicate that both of these statements hold true, depending on the nature of other forces at work in the area.
Table 3. Average annual cotton production, world and United States, and United States exports for specified periods

<table>
<thead>
<tr>
<th>Period</th>
<th>Production (1000 bales)</th>
<th>United States net exports (1000 bales)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>World</td>
<td>United States</td>
</tr>
<tr>
<td>1910-19</td>
<td>20,398</td>
<td>12,860</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7,502</td>
</tr>
<tr>
<td>1920-29</td>
<td>23,989</td>
<td>13,124</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7,426</td>
</tr>
<tr>
<td>1930-39</td>
<td>26,381</td>
<td>13,458</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6,617</td>
</tr>
</tbody>
</table>

Source: Agricultural Statistics.

A very important force is to be found in foreign competition. Other parts of the world have increased production while United States' exports have dropped rapidly since 1920 (Table 3). Too, the "Old South" must now compete with newer areas within the United States.

Larger farms are developing in the old cotton area, not because mechanization has been an important force to date, but because numerous other forces have pushed incomes of cotton producers downward. Further adjustments in farm size must still come about if cotton producers are to stand on their own feet in the future.

A force of a different nature has been operative in the dairy areas of the nation. Although the dairy areas, like the old cotton areas, have not seen rapid strides in mechanization, they have not been without technological change. Elwood et al. (21) show that between the two periods 1909-13 and 1937-40 milk production per cow increased from 4,551 to 5,435
pounds in the Eastern Dairy Area and from 4,466 to 5,398 pounds for
the Western Dairy Area of the nation.

Why has not this increased productivity for dairy products had an
effect similar to the non-mechanical forces affecting cotton farms? The
explanation lies in the fact that while the cotton situation parallels
the case of "improved technology and an inelastic demand", the dairy
situation more nearly parallels the case of "improved technology in
conjunction with an elastic demand". At least the demand for dairy
products has been increasing with a growing population and in the absence
of effective international competition. The price of dairy products has
remained at a higher relative level than has the price of most other groups
of agricultural commodities (Table 4). Thus the combination of improved

<table>
<thead>
<tr>
<th>Commodity</th>
<th>1920-29</th>
<th>1930-39</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy products</td>
<td>105</td>
<td>71</td>
</tr>
<tr>
<td>Cotton products</td>
<td>88</td>
<td>55</td>
</tr>
<tr>
<td>Wheat</td>
<td>97</td>
<td>63</td>
</tr>
<tr>
<td>All grains</td>
<td>109</td>
<td>66</td>
</tr>
</tbody>
</table>

Source: Agricultural Statistics

technology and a greater elasticity of demand has not made necessary the
farm size adjustments which have held in the cotton areas.
Other combinations could also be pointed out. The decline in exports of wheat has augmented the effects of mechanisation in bringing about size adjustments for wheat farms. The effect of hybrid corn might eventually be that of forcing expansion of corn belt farms. This may especially be true should the demand prove to be inelastic in a normal economy lacking in production controls and price supports. Enough cases have been cited, however, to suggest reasons for patterns in farm size adjustments.

Certain conclusions are now in order. Mechanisation, the force usually stressed, may or may not force size adjustments. The outcome depends on the availability of additional land. Other forces can be equal to or greater than mechanisation in forcing size adjustments. These are the logical conclusions when the analysis is based not on the assumption that each firm is able to adopt the optimum scale of operations but on the more realistic assumption that the greatest numbers in agriculture are limited to a scale of less than optimum.

**Capital rationing and farm size**

The foregoing discussion has focused on forces which tend to bring about adjustments in farm size. The discussion immediately following is focused on forces which tend to prevent adjustments in the direction of the optimum-sized farm. Of course, once these limitations are lessened they allow adjustments in size.

A basic postulate employed in the theory of the firm is that all firms have access to unlimited resources. Under these assumptions it is possible for the firm to maximise returns by equating marginal cost
and marginal revenue. This supposition is highly unrealistic in agriculture.

The majority of farm operators is prevented from attaining an optimum-sized unit simply because they do not have and cannot (or do not) borrow the capital to do so. Capital is not so freely accessible as is assumed in the theory of the firm. It is rationed to the farm operator either by himself or by credit agencies.

The greatest number of farmers probably push the size of operation to the limit allowed by the capital which they own or can (or are willing) to borrow. That this is often the case is evidenced in an Iowa study (43). Farmers grouped according to level of income were questioned as to why they did not expand operations. Eighty-one per cent of the low income farmers (the lower one-third) stated that their scale of operations was limited by a lack of capital. Only 24 per cent of the high-income group and 53 per cent of the middle income group indicated capital as the limiting factor. However, capital was probably the limiting factor for a greater number than the above figures indicate. A relatively large number in all groups stated that lack of labor was the limiting factor in scale of operations. However, had the capital been available they could have hired the labor needed for expansion.

Forms of capital rationing. Prospects are that for the largest number of farmers, capital will long remain the all-important limit to farm size. Limitations on the capital used by the farmer are of two sorts: One is capital rationing imposed by established credit agencies. The credit extended to the operator is based upon and limited by the collateral
which he can furnish. Credit is not often extended beyond 60-75 per cent of the collateral and certainly not beyond 100 per cent. The second type has been termed self-imposed capital rationing. Although this may not be the best suited terminology it is certain that some operators who could borrow funds and expand operations are not willing to do so. This self-imposed limitation or the use of capital was found to be true in a study by Witt (86).

The lack of interest in the use of credit for extending operations stems from several directions. One of these is probably lack of knowledge as to the profitableness of added investment. Another is based upon economic considerations; risks and uncertainties resulting from fluctuations in price and production make some farmers hesitant in borrowing funds. Still another is based upon custom and tradition; children are taught by their parents to avoid debt, to repay contracted debts as soon as possible and that there is a social stigma associated with debt. Too, the farm family may think in terms of the interest and principle payments as additional burdens to family living rather than in terms of the additional returns forthcoming even where the loan is profitable. They sometimes do not differentiate between loans for consumption and production purposes.

Self-imposed capital rationing arising out of price uncertainties may be tied closely to the operator's equity in the capital employed. The smaller is the operator's equity in his business; the greater is the risk that he will lose all in event of a price decline should he borrow additional funds for business expansion. For example, an operator who
has an original equity of only 25 per cent and who borrows an additional amount equal to 25 per cent of all capital employed may lose control of the entire unit if the price level falls by a relatively small amount. In contrast, an operator with an equity of 60 per cent does not take on an equal degree of risk if he borrows an additional 25 per cent.

Form of business organization. Capital rationing which is not self-imposed is undoubtedly the greatest limit to farm size. This limitation to firm size is in contrast to other industries in which the important volume of business is accomplished by corporations. The corporation can draw funds from many households. It can draw greater funds from outside the industry and is not necessarily dependent upon the savings of owners or workers in the organization. In agriculture most of the machinery, semi-finished products and equipment is owned by the families which use them. Accumulation of additional capital must come mainly from the family’s income after yearly expense and family living have been provided for.

The predominance of single proprietorships in agriculture means that ordinarily the capital accumulated by one individual is divided among his heirs at the time of his death. Hence, in the typical case, the farm may be operated as two or more distinct units or one heir may buy the shares of others. In either case the process of capital accumulation and the increase in owner’s equity must largely start over again. The firm in agriculture is a one generation affair.\(^1\) In contrast, the com-

\(^1\)The situation in agriculture is paralleled by that of other small scale industries such as grocery stores, filling stations, barber shops and similar lines.
timidity of life for the corporation in other industries more nearly allows an approach to the optimum size or the maintenance of optimum size once it is attained.

Of course the farmer has an opportunity to acquire the use of capital aside from that owned or borrowed. He can rent certain assets, chiefly land and improvements. Involuntary capital rationing is less of a deterrent to scale of operations in the case of tenant farmers than in the case of those who desire title to the non-human resources they employ. The operator who chooses to expand extensively through renting additional land is not restricted in the same degree, providing the land is available, as is the individual who wishes to own any additional land operated. However, even the tenant farmer is most often held to a scale of less than optimum size. The amount of land he can operate is tied to the amount of machinery and other such capital which he controls. Certainly, capital rationing limits the scale of livestock production on tenant farms by as much or more than on owned farms.

The rented farm has one additional advantage over the owned farm in respect to size and capital rationing. Not only will a given investment allow the operation of more rented land in cases of creditor-imposed capital rationing but the degree of so-called self-imposed capital rationing may also be less of a deterrent. The operator of rented land stands to lose less from fluctuating prices and yields than does the person who invests in the title to the land. Thus he is more often willing to expand his operations to a scale beyond that of the full owner.
Permanence of capital rationing. As long as the single proprietorship is the predominant form of business organization prevailing in agriculture, capital rationing will continue to be a greater force in determining size of operations than will the principle of equal marginal costs and marginal revenues. Contrary to the oft-expressed predictions of the 1920's, the move towards corporate owned and operated farms has shown no wholesale trend. The percentage of farms operated by managers was 1.1 per cent of all farms in 1920 and .6 per cent in 1940 (Table 5). The percentage of land area so operated was somewhat greater in the latter year but still represents an insignificant total as compared to other industries. These managed farms roughly coincide with the group of farms which are owned by corporations, large estates and other absentee landlords. Too, the increase of 1940 over 1930 includes some

<table>
<thead>
<tr>
<th>Year</th>
<th>Per cent of farms</th>
<th>Per cent of farm land</th>
</tr>
</thead>
<tbody>
<tr>
<td>1900</td>
<td>.9</td>
<td>10.4</td>
</tr>
<tr>
<td>1910</td>
<td>.9</td>
<td>6.1</td>
</tr>
<tr>
<td>1920</td>
<td>1.1</td>
<td>5.7</td>
</tr>
<tr>
<td>1930</td>
<td>.9</td>
<td>6.3</td>
</tr>
<tr>
<td>1940</td>
<td>.6</td>
<td>6.3</td>
</tr>
</tbody>
</table>

Source: U.S. Census (80)
lands which are still owned by credit agencies as a result of the 1930's
foreclosures. The latter does not necessarily represent a move toward
corporate ownership.

The spatial factor and seasonality of operations are probably the
reasons that the mass-production corporation has not become important in
agriculture. There is not the opportunity to take advantage of the
division and simplification of tasks, for the close supervision of large
numbers of workers and similar considerations which have lead to the
corporate form of business in other industries. This will likely hold
as true in the future as in the past. Therefore the limitation of
capital will continue to be the all important force determining scale of
operations in agriculture.

Mechanisation and capital rationing. Finally, the capital complex
has as often been the key to farm size adjustments resulting from
mechanisation as have been changes in cost relationships. The most
important mechanical development in agriculture has been the tractor and
tractor-drawn equipment. Before adoption of these machines, the typical
family has tended to operate at a scale possible in terms of its capital
or labor supply. With a somewhat similar capital investment it has
been able to substitute tractor power and tractor machinery for horses
and horse machinery. The marked change has not been in the total capital
investment but the form of the capital employed. However, the similar
capital investment has made possible greater scale operations with the
previous or a smaller amount of labor. The family has tended to expand
mean more important forces of the nature that have been the important interaction
in the pastressed or the smaller number of workers per family in
estimating the size of the unit through the adaptation of improved employment
level have been on the farm family for two years with the possession of in-
the past season decreased as long as the production unit in agriculture
in employment, an attestation to the concept that has been on the decline over
the size of the family represented of all workers employed on farms. The size of the family
1890-95 and 1890-95 family workers conscripted 70 or and 77 per cent.

Agricultural censuses (19) show that for the three periods 1910-19,
industries of such subject as a family affected
under the specific activities affecting more than any other
searched or operation on the family size
household aspects. Increased in the group of forces within the
expansion of which are opened through mechanization or other developments
the optimum. Liberty, they provide opportunity in the population of
these forces not only extend the opportunities in some of operations toward

certain other forces have an inresistable effect on farm size.

Institutional and resistance forces

*Armed

other occupations in the manner suggested in a preceding section of this
other occupations in the manner suggested in a preceding section of this
is available. Land will be available if some other occupations more so
before the family can expand operations, it must wait until necessary land
a Green Lake supplied can now handle a greater volume of business. Yet
operations not so much because fixed costs are than decreased but because operations
(depressions excepted) of farm-reared children to towns and cities, which has been suggested in such studies as that of Baker (4). In many cases a tractor has been employed as one member of the family left the farm or if a tractor was already in use, larger capacity tillage and planting equipment has been employed.

That the size of many farms would be greater if additional family labor were available is suggested in the Iowa study previously cited. Fifty-two per cent of the farmers in the lower one-third of the income bracket indicated that lack of labor was a factor limiting size. Thirty-two per cent of those falling in the upper two-thirds so indicated. Obviously, these farmers were referring mainly to family labor, since an ample supply of hired labor was available in the year of the study. These farmers either did not have the capital or were unwilling to pay out funds for hired labor else they would have done so. Yet had the family labor been available at little or no cost, it would have been used in expanding scale of operations.

There are also other factors tied quite closely to the farm family and which impede farm size adjustments. The fact that the farm is not only a business firm but is also the family home is not considered in the theory of the firm. The cords of sentiment often tie the farm owner to his land even though his net returns for the existing unit are less than for other alternatives and in spite of the fact that he can't adjust to the optimum scale. The farm is his home. It represents the reward for his toil and that of his family. A change to other types of work
means leaving the hard-won home. This is not so true in other industries
where it is possible for the laborer to change jobs without moving his
home.\(^1\) As long as farm operators thus cling to inadequate units the
decline in numbers and consequent consolidation and expansion of other
units is prevented.

**Uncertainty.** Another factor which may restrict farm size to less
than the optimum is uncertainty. This factor has already been discussed
and needs little, if any, qualification from that set out in other parts
of this section. An Iowa study (43) indicated that 15 per cent of all
farmers included in the study refrained from expanding operations because
they were "uncertain" as to the future. The term "uncertain" was not
explained and is thus rather nebulous. It might have included uncertainty
in respect to personal health, weather, wars, strikes, prices and any
number of other factors.

**Discontinuity in supply of factors.** Another resistance to farm size
expansion is to be found in the discontinuity of certain production
factors. This is partially true in the case of such capital as the farm
tractor. A farm operator who is using his present power and equipment to
full capacity may feel that it would pay him to farm an additional twenty
or forty acres were it possible for him to combine other factors prop-

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\(^1\) Again the case of agriculture is somewhat paralleled in such small
scale industries where the production plant is also the home. Such
cases in which the home may be combined with the unit sometimes holds
in the case of tailor shops, grocery stores and others. However, the
number of such instances is much less frequent than in agriculture.
tionately. Yet the addition of a small amount of land might necessitate the addition of an entire tractor thus making the cost prohibitive.

The problem can be partially solved in the case of power and machinery, however, through the use of smaller-type tractors and the availability of custom work. This is not so true for other factors in which the discontinuity is of another nature. The supply of land available to the operator typically comes in multiples or fractions of quarter sections. Aside from urban regions, areas settled early in the history of the nation and other scattered exceptions, land ownership is transferred only infrequently in parcels of less than 40 acres in the major areas of the United States. More often the minimum unit is 80 or even 160 acres. This situation stems from numerous factors. Policy in respect to mensuration and disposal of public lands by the federal government established a precedent to which private owners have rather rigidly adhered in transfers. The employment of the square mile and quarters thereof as the standard units of measurement was one force in this direction. Another was the offering of tracts in the same multiples for direct sale, military grants, homestead claims, and other methods of disposal. The development of roads along section lines was still another. These policies not only set up a customary pattern for the unit sale of land but also established a pattern of farm size, especially for a span of years immediately following such policies.

Were it possible to acquire additional land in parcels of convenient size and shape many relatively small owned-farms would probably expand operations. For example, many operators of 40, 80, 120 or even 160
acres may have the labor, equipment and capital to take on another 10, 20 or 30 acres. Yet the traditional unit of division means that farms will not be sold in such fractions as long as buyers which will take the entire unit are available. Too, the immobility of land tends to hamper the division of an 80, for example, into units of 10-30 acres each. It would be a coincidence if several bordering farms each should wish such small units. Furthermore, were it impossible to sell one or two such units to farms neighboring the tract it would be increasingly difficult to sell to other owners more distant. The buyer might well refuse to purchase this small unit unless it were immediately joined with his own farm and also stretched the entire length or breadth of his present holdings. But present institutional factors are such that land is not customarily sold in such small units and even where such is true the tract most often is across the road from the farm and of such dimensions that fencing and operational costs are high.

The tenant farmer is similarly prevented from expanding his operations by small increments where such is both possible and profitable in light of present supplies of labor, equipment and capital. The owner of land prefers to rent a tract of reasonable size as a unit rather than to bother with the additional supervision, fencing costs and similar considerations which are encountered for a number of small subdivisions. The investment sunk in buildings also accentuates the tendency to rent farms as a whole. As long as the demand for farms by tenants is sufficiently great, the landlord can ordinarily realize some amount of cash return on
this investment which would be impossible if the land were subdivided and the buildings left idle. Again, the immobility of land serves as a hindrance to the operator who would be willing to rent a nearby parcel but who is unwilling to stand the relatively higher costs coincident with operating a small unit which may be remotely available. These several considerations serve to partially arrest the tendency to consolidate units and expand scale of operations. This is especially true in areas in which crops represent an important portion of the farm business.

Tenancy. Another institutional factor acting as an obstacle to a greater scale of operations hinges around tenure. Length of tenure is especially important in preventing an expansion through intensification of operations. Schickels and Himmel (63) found that the type of lease and length of occupancy affect the farm organisation. The crop share lease, specifying only one year's occupancy, definitely discourages the development of livestock enterprises. The tenant especially refrains from expanding operations which will require a fixed investment as long as no provision exists for unexhausted resources. He even withholds investment from small equipment or breeding stock which will not turn over completely within the year. A move would require either the liquidation or the expense of moving these items. True, he may still be on the place at the end of another five years, but at the time of planning one year's operations he never knows when or how far he will have to move in the future. His operations are thus held at a scale of less than optimum or that possible in light of his capital and labor supply.
There are other miscellaneous forces which impede the adjustment of farm size in the direction of the optimum scale.\(^1\) Such cases as these are less important, both numerically and otherwise, than the other impediments which have been mentioned.

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\(^1\)Some persons might suggest that management is a limiting factor since some operators have expanded as far as is profitable in light of their managerial ability. Such operators can, however, be considered as having attained the optimum size and need not be included in a discussion of forces which impede adjustments to the optimum scale.
HISTORY AND PATTERN OF FARM SIZE CHANGE IN IOWA

Much interest has centered around the consolidation of farms in Iowa. Unofficial estimates have often placed the number of consolidations at a high level. Some have expressed the opinion that an unduly large number of families are being forced off of farms as a result of the increase in the acreage of some units. It has also been implied that acreage adjustment is a recent phenomenon resulting from mechanization and that rapid increases in the acreage per farm will continue.

But what have actually been the trends? Has the number of consolidations been as great as is commonly supposed? Is the adjustment in farm size only a recent development? If not, how do present trends compare with those of the past? What are the chief causes of farm acreage adjustments in Iowa? What factors have been important in molding farm size? What farms have been increasing in size; is it the small unit which has been expanding in acreage or is it the farm which is already large?

In order that some objective answers to these and related questions be provided, this section on the history and pattern of farm size in Iowa has been included in this study. It represents an attempt to trace and analyze recent changes. It also traces historic developments in farm size adjustments. Although the first of these is of the greater current concern, a study of the latter makes possible a better understanding of (1) long-run trends in farm size, (2) the many forces motivating farm size
adjustments and (3) the various forces molding the pattern of farm size. Knowledge of these is especially necessary if the mistake of over-emphasizing one or a few forces is to be avoided.

Obviously, the most meaningful measure of size for the analysis of these problems is acres. This is only one measure of farm size, yet it is the crucial measure in this case. The number of farms and farm families which can exist at any one time depends on the average number of acres per farm.

Source of Data

The data upon which this section is based were taken from the United States census. These are practically the only data available for the examination of long-run trends. Of course one might take random samples in the state which would give the extent of farm consolidation for one or a few years, depending on how far back present operators could remember the number and extent of consolidations in the neighborhood. Although a study of this nature gives a great deal of detailed information on the consolidations in any one year, the survey is not only a sample of farms within the geographic area under consideration but also only one sample over time. Thus it does not allow the analysis of long-run trends.

There are certain objections to the use of census data in studies dealing with members of farms or the average acreage per farm. The most serious objection has to do with the definition of a farm and the inclusion

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1The decennial census is only a sample in time but enough of these are available to make possible some indication of trends.
(or exclusion) of those farms on the borderline of the criterion employed. This complexity is greatest for comparisons between the regular decennial census and the intervening five-year census. It is quite evident that the two have not been comparable on the basis of the number of small units included. Although the definition of a farm used has been the same, the five-year census seems to include certain small farms that are not included in the decennial census. There are several reasons why this is so. In the first place, the amount of funds available for the five-year census necessitates a less accurate enumeration. However, the most important reason is probably this. In the regular decennial census a population schedule is used along with the farm schedule. This requires that the enumerator visit all families. If the family qualifies as a farm family he then fills in the agricultural schedule. Since all families are to be included the incentive to manipulate the number and location of schedules taken is less than for the five-year census. The five-year census includes only farm families. The enumerator, basing his action on his own observation as to which are and which are not farms, may not go near farms which are included in the ten-year census. However, the opposite is probably more common in such states as Iowa. The enumerator for the five-year census obtains schedules for units which are not included as farms in the decennial census. This tends to be true since there is no check against a population schedule and since it is easier and more profitable for the enumerator to include a large number of very small units on the outskirts of cities and towns even though these units may
not actually come under the definition of a farm. Too, there may be some small tendency for the enumerator of the five-year census to exclude a few large units which are more distant from towns since it is not necessary that these farms be visited for a population schedule.

For these reasons only a small amount of use has been made of the five-year census in this study. It is of course true that some differences may exist even between the different years in the regular decennial census. The farm which was classified as a farm in 1930, for example, may not have been included in 1930 even though it is exactly identical in size and physical production. Too, when consolidation of farms is being considered, the census definition brings forth another difficulty. For census purposes a tract is defined as a farm if it includes three or more acres of land or if its agricultural production for the census year amounted to $250 or more. This definition leads to complexities in the case of operators who retire on farms. For example, suppose an elderly operator who has been operating 160 acres retires on the farm by retaining the use of the buildings and lots. Five acres are included in the farmstead. According to the census definition the farmstead may be included as a farm even though an insignificant amount of production is carried on. If this operator rents the remaining 155 acres to a neighbor who also operates 160 acres the average size of farm will be the same as before the consolidation. Before the consolidation two farms of 160 acres existed and the average for the two farms was actually 160 acres. After the consolidation and according to the census definition, two farms still
exist—one of 5 acres and one of 315 acres. The average is still considered as 160 acres.

Thus the main weakness in the use of census data rests on the definition of a farm. Lack of reliability falls mainly in those size groups in which any question exists as to whether or not the unit is actually a farm. Lack of reliability falls mainly in those size groups in which any question exists as to whether or not the unit is actually a farm. Some small amount of error may also hold in the larger size groups but it is hardly possible that these are great enough to obscure any trends in farm size.

In order to get around the errors resulting from the definition of a farm, the conclusions of this study are based, wherever such is possible, upon the distribution of farms by size as well as on the average acreage per farm. Further, the use of farm size distributions allows the exclusion of those groups in which there may be some doubt as to the definition of a farm. In Iowa exclusion of the farms of nineteen acres or less should remove most of this difficulty. Most units of twenty acres and over could undoubtedly be classified as farms since the problem of estates which include a large number of acres but which are not farms is unimportant in Iowa. Too, any farmstead which includes as much as twenty acres will, with few if any exceptions, be part of a bona fide farm. There are very few farms of less than twenty acres which are agriculturally important in the state. Some few highly specialised small units do exist. However, these units are not important when problems of consolidation are being considered. The return to the operator of such units is mostly
attributable to labor or capital and hence competition with large operators on a basis of rents is hardly effective. Further, the regular commercial farmer who wishes to expand his operations does not go out searching for a five, ten or even a nineteen acre plot. True trends in farm consolidations can even be spotted in the size range of fifty acres and over if they are actually taking place. For the above reasons the size group 9-19 acres has been excluded from the distributions in this section. Distributions which include this size group are included in the appendix. In no case would the main conclusions of this study have been altered by substituting the distribution which includes the 9-19 acre group for the one that does not.

Data on the distributions of farms by size groups were not available for the early years in the history of the state. However, since the trends for the early period are so pronounced the figures on average size can be used with confidence. All data presented in the tables as figures of this section are either taken directly or derived from census data unless otherwise indicated.

History of Farm Size

The initial pattern of farm size in Iowa, as in other midwest and western states, was largely established by the nature of early land settlement and land disposal policies and by the fact that the standard used for dividing the land area was the 640 acre section. In fact, a first stage in pattern of farm size was established in Iowa even before the disposal of the public domain began. Although surveying of the
Half-Breed Tract (the triangular part of Lee county) was completed in March of 1852, the general survey of public lands in Iowa did not begin until the autumn of 1836. Actually, "squatters" often preceded the running of survey lines and the marking of corners. Settlement of the Black Hawk Purchase began as soon as Indian occupancy was terminated on June 1, 1833, even though the survey was not started until 3 years later.

**Settlers' claims**

Over ten thousand persons were living in Iowa by 1836 when the survey of the Black Hawk Purchase was initiated (46). These "squatters" were, in the interpretation of a congressional act of 1807, trespassers upon the public domain. They did not own their claims and had no legal rights to their holdings. Accordingly, they might have staked out a claim of any size whatsoever. Their legal rights were no greater or no less for a large claim than for one of medium or small size. Yet a definite pattern of farm size existed even at that pioneer time.

The typical claim was apparently one of 320 acres according to Lokken's (45) description of squatters' land measurement. The absence of section lines was no obstacle to the pioneers. They used the sun at noon and evening as a guide in establishing claim lines and counted off so many steps each way for 320 acres, the area of a claim. It was recognized that these lines were far from correct but it was understood among squatters that these inequalities would be rectified once the lands were surveyed and entered. A section line through a claim would mean that the area lost on one side would be offset by that gained on the other.
That the typical claim of the first settlers was 320 acres if also substantiated elsewhere. Taylor (72) quotes a claim association of Marion county as follows: ¹

Whereas, it has become a custom in the western states, as soon as the Indian title to the public lands has been extinguished by the general government, for the citizens of the United States to settle upon and improve said lands, and heretofore, the improvement and claim of the settler, to the extent of three hundred and twenty acres, has been respected by both the citizens and laws of Iowa....Resolved, that we will protect all citizens upon the public lands, in the peaceable possession of their claims, to the extent of three hundred and twenty acres, for two years after the land sales, and longer if necessary.

According to Dannel (20) a provision of the Jefferson County Claim Association stated that any person twenty-one years old, or any other person at the head of a family could "possess him or herself of three hundred and twenty acres belonging to the government, and not legally claimed by other persons". Shambough (66) indicates that the Johnson County Claim Association allowed each settler to stake out a claim of 480 acres.

The most common maximum seems to have been 320 acres. Of course some claims of less than the maximum size allowed by the "squatters".

¹A claim association was an organization established by the "squatters" to protect the individual's interest in the claim which he had staked out. The "squatters" had no legal right to their claims and any outsider had legal authority to buy the land which had been set up as a claim. By group action the claim associations were able to minimize such proceedings. In some cases where an outsider took over a claim, the association drove him away by numerous thrashings, by burning his cabin and by similar practices.
unofficial laws were staked. However, as would be expected, each settler tended to stake off the maximum. Thus the average size of farms was larger during the period of infancy in the state's agricultural development than for any subsequent period. Even if today's definitions were to be used as the measuring stick, the "squatter's" claim was not a family-sized unit. It was greater than family size in terms of labor requirements. The family could not possibly hope to stock and till the entire unit. Too, it was not a family-sized unit in terms of the "squatter's" customary standard of income. He was able to cultivate and live from only a fraction of the claim. The remainder was left idle or was utilized only very extensively. Several additional families might have eked a similar real income from the same 320 acres.

The pioneer farmer took over such a large unit not because he expected to cultivate a major portion of it but because of his hope of gain. He was undoubtedly aware of the appreciation of land values which took place in other states as they were settled. Thus the large unit not only gave the pioneer farmer and his family a home and a tract of land from which they might earn their livelihood but it was also a potential capital gain should the area become thickly settled. Some probably expected that, although cultivation and stocking of the entire unit was impossible at the outset, they might accumulate enough capital to buy the tools and hire the labor for the cultivation of a large acreage or to purchase the livestock for grazing, a less intensive type of farming.

He probably did not take more for several reasons. As already suggested, even 320 acres was more than he could hope to cultivate.
Selection of full sections would have resulted in a very widely scattered community. More could hardly be justified in cases where a large number wished to settle in a limited area. Too, the pioneer probably realized that the possibility of his being able to purchase 320 acres or that the government might turn as much over to him for settling the land was only wishful thinking.

But why did the "squatter" select exactly 320 acres? Why did he not select, for example, 500 acres or 350 acres, since the difference is not very great? The reason that exactly 320 acres instead of some other amount was selected probably rests on the fact that the standard unit of measurement employed in surveying the public domain was 640 acres. The 640 acre section was too much land for the "squatter" so he simply took one-half or 320 acres. Had the public domain been laid off in blocks of other sizes it is entirely possible that the modal farm size would not have been exactly 320 acres. For example, if the public domain had been divided into units of 800 acres each the "squatter" might have taken one-half of this or 400 acres. Or, if it had been measured off in units of 800 acres the typical "squatter" unit might have been 300 acres. Thus the individual who originally devised the 640 standard for dividing the public domain established a powerful precedent for farm size. This was true not only for the initial pattern of farm size in the state but also for subsequent developments. For example, it was only natural to divide the 640 acre unit into two of 320 acres, the 320 acre unit into two of 160, the 160 acre unit into two of 80 and the 80 acre unit into two of 40 acres.
Had the original unit been 600 acres the sequence of division might have been two 300's, two 150's, two 75's or three 50's. Had the original unit been 800 acres the sequence might have been two 400's, two 200's, two 100's and two 50's.

Public land disposal policy

A new pattern of farm size followed close upon the heels of that of the first "squatters". This next stage in the pattern of farm size more nearly revolved around public land disposal policy. The first sale of public lands in Iowa was held at Dubuque in 1838. However, Congress enacted measures in each of the years 1830, 1832 and 1834 which gave the "squatter" preemption rights to his claim in case the land had been surveyed. Under these acts any settler who had occupied and cultivated a quarter section during the preceding year was authorized to buy the same at the minimum price of $1.25 per acre. The acts of each of these years only legalized claims already established; they did not grant preemption rights to future "squatters". Furthermore, the acts of the first few years meant little to Iowa settlers since survey of the Black Hawk Purchase was not completed until 1837 (46). However, the settlers now had some assurance that they would eventually be able to buy their homes at reasonable terms; they might at least expect subsequent acts which would make them eligible once the surveys were completed.

The fact that the maximum to be expected under preemption rights was 160 acres should have forced a trend toward claims of this size rather than the former customary claim of 530 acres. Once the right of preemption could be exercised after the annual acts of 1838 and 1840 and
the more permanent act of 1841, the modal farm size became 160 acres. Any individual could now enter his claim before the land went on sale. Preemption claims were again limited to 160 acres and in addition no person could own more than one claim; nor was any person eligible who owned 320 acres in any other state or territory.

Many settlers were unable to scrape together the necessary funds to enter their claims before the public land sales and any person had legal right to bid on land for which preemption rights had not been exercised. Thus it might seem that large holdings might have been acquired once public sales were held. This was true to some extent. Yet the typical unit sold to settlers was still the quarter section. Lokken (46) describes the settlers' unofficial laws which protected the interests of the "squatter" at the land sales and allowed him to buy his 160 acre claim at the minimum even if he had not exercised preemption rights but was now financially able to bid the $1.25 per acre. The settlers, summarizing punishing outsiders who bid on claims, were able to minimize such "unscrupulous practices" and safeguard the "squatter's" claim to 160 acres.

Land was apparently auctioned in these minimum units with few exceptions. On the other hand, the "squatter" could not often acquire more than $200, the minimum price of 160 acres. Even then a large portion of the purchase price was borrowed at exorbitant interest rates.

Were it possible to show a frequency distribution of farms by size for this period of early land ownership in Iowa, the distribution undoubtedly would be skewed to the left. Whereas the quarter section was the modal-sized unit it was also practically the minimum. On the other hand the
number of farms over 160 acres was greater than the number of those less than this size. It is reported that some small speculator-farmers bought land for speculative purposes (46). Too, some persons who were not speculators and whose intentions were purely agrarian had the funds for more than 160 acres.

Even after the first preemption rights and public land sales land disposal policy continued to mold the pattern of farm size for some years. Disposal of the public domain by means of military warrants began under the act of 1847. Under this act certain qualified soldiers from the Mexican War or their heirs were to receive a bounty of 160 acres of land provided these veterans had served in the volunteer army for twelve months or had been discharged for sickness or wounds. This act also provided land warrants of forty acres for those who had served less than twelve months. An act of 1850 granted eighty acre warrants for services in any Indian war since 1790, the war of 1812 and to commissioned officers in the war with Mexico. An act of 1852 made land grants assignable while an act of 1855 provided for 120 acre, 100 acre, 60 acre and 10 acre warrants and extended the bounty land privilege to thirty-two classes of persons within the army, navy and other services (46). Evidently these smaller grants represented a means of bringing all land bounties up to 160 acres since the latter act made 160 acres the minimum and provided additional grants to make up the total for those who had received less. Some of the grants were actually utilized by veterans who wished to settle upon the land. Probably a greater number of the warrants were purchased by others who wished to farm. A relatively large number were also purchased by persons who aspired to hold the land for speculative purposes.
Thus the early pattern of farm size was maintained; the typical unit remained at 160 acres while the average remained greater than a quarter section due to the larger land holdings of speculators and others where the units were organized as farms. This latter fact is expressed in Table 6 which shows that the average size of farm was 185 acres in 1850. Additional methods of land disposal tended to perpetuate this pattern. Still other less important grants probably helped break the precedent of 160 acre minimum units.

Secondary disposal agencies and other forces

The average farm size diminished by twenty acres from 1850 to 1860 and by thirty-one acres from 1860 to 1870 according to census data. This relatively sharp decline in average farm size was the result of several factors. Important factors include: (1) nature of land transfers and transferring agents, (2) business conditions and (3) maturing of the pioneer economy.

By 1865 only four and one-half of the original thirty-six million acres remained as public domain in Iowa. By 1870 the federal government held only about one million acres. Much of the non-federally owned land, however, was not included in farms. Census figures show only ten million acres in farms for 1860 and only fifteen and one-half million in 1870. Much of this land was still held by the state through such grants as the sixteenth-section grant, the five-hundred-thousand acre grant, the university grant, the agricultural college grants, the saline grant and the swamp-land grants. Some land was already held by the railroads.
A relatively large acreage was held by speculators who had procured ownership through purchase of military warrants or otherwise.

Table 6. Land in farms, number of farms and average acres per farm, Iowa census years 1850-1940

<table>
<thead>
<tr>
<th>Year</th>
<th>Total land in farms (000's)</th>
<th>Number of farms</th>
<th>Average acres per farm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1850</td>
<td>2,736</td>
<td>14,805</td>
<td>184.8</td>
</tr>
<tr>
<td>1860</td>
<td>10,070</td>
<td>61,165</td>
<td>164.6</td>
</tr>
<tr>
<td>1870</td>
<td>15,562</td>
<td>116,302</td>
<td>133.6</td>
</tr>
<tr>
<td>1880</td>
<td>24,785</td>
<td>185,951</td>
<td>135.5</td>
</tr>
<tr>
<td>1890</td>
<td>30,492</td>
<td>201,303</td>
<td>151.0</td>
</tr>
<tr>
<td>1900</td>
<td>34,574</td>
<td>228,622</td>
<td>151.2</td>
</tr>
<tr>
<td>1910</td>
<td>33,931</td>
<td>217,044</td>
<td>156.3</td>
</tr>
<tr>
<td>1920</td>
<td>33,475</td>
<td>213,439</td>
<td>156.8</td>
</tr>
<tr>
<td>1930</td>
<td>34,019</td>
<td>214,928</td>
<td>158.3</td>
</tr>
<tr>
<td>1940</td>
<td>34,149</td>
<td>213,318</td>
<td>160.1</td>
</tr>
</tbody>
</table>

Although the quarter section was practically the universal unit by which bona fide farmers acquired ownership under purchase from the federal government, this apparently was less true for land sold by the state, railroads or speculators. The latter group of land holders either desired maximum profits or wished to see the state settled at an early date. It is to be expected that they would sell land in units of less than 160 acres whenever such promised to further their ends.

Investigation substantiates this belief. By 1861 the state had sold 253,472 acres of the Des Moines River grant in small parcels and to actual settlers (60). Leases with option to purchase the agricultural college grant were initiated in 1863. The maximum amount leased to each
person at the outset was 160 acres. Paulson (60) indicates that early sales of school land were invariably made to actual settlers and in small units. Howard county swamp lands were sold chiefly from 1869 to 1875 and in units of forty acres each.

Railroad lands, which were sold somewhat later, were transferred to actual farmers in small units. Hibbard (32) states that the parcels sold by the Burlington and Missouri River Railroad Company averaged 180 acres in Iowa and Nebraska. Sales of land made by the Iowa Railroad Company in the state averaged approximately eighty acres (60). 1

Data on sales by speculators is not available. However, the fact that this group of land holders bought up large tracts and held them until most of the free land was taken in the early-settled parts of the state suggests that the sales were in small units rather than the traditional quarter section of the federal government. Speculators bought and held such land for increasing values. The 140 largest purchases made by means of military scrip totalled 1,331,000 acres and averaged 9,880 each. One single purchase was for 200,000 acres. The 54 largest cash purchases totaled 752,588 acres, an average of 13,938 each. One large tract, purchased partly in scrip and partly in cash, totaled 344,578 acres (32). These holdings were not considered as land in farms and most large speculators had liquidated their holdings to settlers by 1863. Their

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1It is possible that these sales included some units laid out as town sites and thus the average figures would be less than if only farm lands were included. However, there is ample evidence that sales of farm units averaged less than for the sales by the federal government.
lust for profits resulted in sales of 120, 80 or even 40 acre tracts to settlers who had only a limited amount of capital.

The traditional minimum unit of 160 acres was thus partially removed in favor of smaller purchases. A large number of 160 acre farms still existed but the addition of a large number of smaller farms meant a decrease in the average farm size.

In addition to the fact that land could be purchased in smaller units, more persons were now willing to accept less. The fact that the bulk of the public domain, and especially the more desirable land, has passed into the hands of private individuals or the state government increased the willingness of new operators to be content with less than 160 acres. Previously there had been little need to accept less than 160 acres since this amount was readily available in the vicinity as a part of the public domain. As the public domain dwindled, however, it became necessary to search farther and farther for desirable tracts. Thus, the person wishing to settle in the vicinity of friends or relatives was more content to buy an 80 or 120 acre unit than when the traditional quarter section could be obtained only a few miles distant at the minimum price of $1.25 per acre.

That depressions are accompanied by farm size adjustments is apparent when one examines recent economic phenomenon. Certainly this must have been a factor of some importance affecting the decline of farm size from 1850 to 1870. The depression which started in 1857, while short-lived, was extremely sharp and land values dropped from $10 to $2 and $4 per acre. These depressions especially burdened pioneer farmers. Many had purchased
farms with money borrowed at extremely high interest rates. At one time after the 1857 crash one-half the land in Hamilton county was advertised for the tax sale. Taxes were delinquent for 2 and 3 years on most land so advertised (33). Some farmers were thus forced to sell portions of their farms in order to retain the rest. Too, lack of funds limited the number of acres which the newly-arrived settler could purchase and, in contrast to the major period of public domain liquidation, it was now more nearly possible for him to buy in units of less than 160 acres. That a large portion of this decline in farm size resulted from a division of existing units as well as from the advent of newly-improved but smaller units is suggested in Table 6. \(^1\) The number of farms increased by 90 per cent while the acreage in farms increased by only 54 per cent in the period 1860-70.

One stage in the maturity of the pioneer economy, apart from depressions, also tended toward division of existing units in the period 1860-70. Some farms had apparently been of greater than optimum size previous to 1850. Certainly one family could not often improve and cultivate a full quarter section previous to this time. The crude tools of the period did not allow it. Likewise, lack of capital prevented many from fully stocking the non-cultivated portion of the farm. The quarter section as a whole was indeed farmed extensively. Yet as long as nearby lands

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\(^1\) Had the decrease been the result of newly-improved units alone, these new units would have averaged only 99 acres per farm. Newly-created farms under the homestead act of 1861 were set at 160 acres each.
could be used for the mere "squattering" there was little chance to dispose of the surplus. However, once the "free" lands were exhausted in the early settled regions the increased demand and consequent increase in land values made possible the division of some units at a profit. Farmers who disposed of the "unutilised" portions of their farms might thus acquire the resources for a more intensive and more profitable operation of the remaining unit. Such a division of existing units would obviously result in a greater percentage of cultivated land. That this division and more intensive cultivation of existing farms took place tends to be substantiated by census figures. During the period 1860-70 the area of improved land in the state increased by 150 per cent as compared to the 54 per cent increase in total farm acres.

The period 1870-80 brought practically no change in average farm size. It seems to have represented a turning point in the trend of farm size. The average acreage per farm veered upward by eighteen acres from 1880 to 1890 and although the data on the numbers of farms by size distribution is meager, that which is available also points in this direction.

As a whole the period 1880-90 was one of prosperity. Although the year 1885 resulted in prices so low that some corn was burned as fuel, farmers had passed through a prosperous period in the early 80's and prices made some recovery after 1886. The further maturing of the economy was, however, probably more important in bringing about the increase in farm size. The new stage in the maturity of the economy, in contrast to the earlier stage mentioned, tended toward larger farms for
The next quarterly period 1990-1990 was one of stability in

Preliminary condemnations 1990-1990

areas.

In Europe and in several of its parts in the number of farms over

per cent in the number of farms over 3 per cent. This is

per cent of all farms over 15 per cent. To this is

number in farms falling in the group 20-99 farms decreased from 22,007 to 17,292

some connection between 1980 and 1980 is introduced in Table 7. The

areas in each of the years 1980-65 introduced (2), on the other hand,


same method is used. In 1980, 1980, and 1980

the areas in each of the years 1980-65 introduced (2), on the other hand,

on the basis of consensus data, the latter was the more important force.

large areas and (3) by the concentration of existing units. To appear,

have resulted from two different methods: (1) through merger and

The interest in Europe during the period which corresponded

from outside.

we no longer at least a hindrance to the flow of concepts into the spaces

held. The expectations of the state had now proven correct and their

some farmers had accumulated enough capital that they might add to their

immense reasons. Afterwards had now passed through the industry and

102
acres of land in farms increased during this period. On the basis of census figures the additional land in farms per added farm average 155 acres between the two years. Thus the creation of new farms would have had little effect on the average size of farms.

However, some shift in the distribution of farms by size groups did take place (Tables 7 and 8). There was a definite trend toward more medium-sized or family-type farms and away from small and large units. The number of farms falling in the range 20-99 acres decreased in each of the ten years of the decennial census and was 22,687 fewer in 1920 than in 1890. The number in the range 500 acres and over decreased by 1,472 or by 44 per cent. The number in the range 260-499 acres decreased although comparisons cannot be made between each of the ten years from 1890 to 1920. Conversely, the number and the percentage of farms falling in the group 100-259 acres made a marked increase. It appears that an equilibrium in size pattern might have followed the adjustment which took place between 1890 and 1920 had not other forces set in. However, around 1920 the adjustment seems to have taken on another nature as will be pointed out later.

The pattern of farm size change which took place between 1890 and 1920 paralleled the relative maturity and stability of the agricultural economy during this period. The maturity of the period became felt in various ways. Land disposal policies no longer had direct bearing on size changes after 1890. The land was fully settled by 1900. Some of the adjustments between size groups probably represented the aftermath
of previous disposal policies. Some units resulting from purchases from railroads and other secondary disposal agencies were probably too small: Expansion was possible as capital was accumulated by some small-scale operators. More favorable income opportunities opened up elsewhere as industrialization of the nation continued. Other farms were too large. A more intensive agriculture developed, thus limiting the acreage that could be tilled by the family with the then current techniques. The townward migration of farm-raised children diminished the family labor supply. Perhaps some farms had even been established on a scale too large for maximum return under the methods of the period. Land was now passing into the second and third generations of owners. Some large holdings were thus divided among heirs and were not recombined since, due to the increase in land values, one heir could not often buy a large unit. Too, industrial and technological development seemed to favor the investment of speculative funds in other than large-scale farm units. Finally, a maturing agricultural economy and exhaustion of public lands resulted in an increased demand for tenant-operated farms and in turn enhanced the possibilities of dividing large units.

The period 1890-1920 was not entirely free from major economic change but it was comparatively calm as compared to preceding and subsequent periods. There were no startling technological changes. Tractors, cornpickers and other labor-saving machines were invented but had not yet been improved to the point where they were widely adopted. No improve-
ments comparable in effect to hybrid corn and recently improved oat and soybean varieties were developed. Complications arising out of foreign trade were mainly felt after the period.

Table 7. Number of farms of over 20 acres by size distribution in Iowa, census years 1880-1940

<table>
<thead>
<tr>
<th>Size groups: 1880</th>
<th>1890</th>
<th>1900</th>
<th>1910</th>
<th>1920</th>
<th>1930</th>
<th>1940</th>
</tr>
</thead>
<tbody>
<tr>
<td>in acres</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-49</td>
<td>23,488</td>
<td>10,418</td>
<td>21,576</td>
<td>15,678</td>
<td>13,117</td>
<td>12,178</td>
</tr>
<tr>
<td>50-99</td>
<td>55,519</td>
<td>53,545</td>
<td>49,665</td>
<td>38,712</td>
<td>36,959</td>
<td>33,209</td>
</tr>
<tr>
<td>100-174</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>80,121</td>
<td>85,569</td>
<td>84,722</td>
</tr>
<tr>
<td>175-299</td>
<td>95,163</td>
<td>121,003</td>
<td>142,676</td>
<td>40,304</td>
<td>41,414</td>
<td>42,815</td>
</tr>
<tr>
<td>200-499</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>25,861</td>
<td>25,865</td>
<td>25,566</td>
</tr>
<tr>
<td>500 &amp; over</td>
<td>2,663</td>
<td>3,588</td>
<td>3,158</td>
<td>2,644</td>
<td>2,014</td>
<td>2,158</td>
</tr>
</tbody>
</table>

All farms over 19 acres 179,832 196,353 219,974 205,520 201,916 199,406 196,696

All farms over 49 acres 186,544 177,934 195,499 187,662 188,791 187,228 184,693

aData not available.

b100-499 inclusive.

Although there were short-lived business recessions and scattered droughts during the period, the severity of these was certainly at a min-

1It is true that experimentation had developed some improvements in breeds, varieties and in husbandry in general, yet none had such sudden impacts on production as the examples cited.
immun as compared to any other similar period since 1833. As a whole, farming was profitable throughout the period. This comparative economic stability and minimum of sudden change was also a favorable environment for an approaching equilibrium and for the pattern of farm size change as outlined above.

Actually the biggest shift in farm size during the period was away from very small farms and toward units of medium size. Had the division of large farms been as frequent as the consolidation of small farms the total number of farms would have changed but little during the period. However, as can be seen in Table 7, there was a net consolidation of 15,956 for all farms over twenty acres from 1900 to 1920. Similarly, the number of farms over forty-nine acres decreased by 6,708. Thus the greatest consolidation seems to have been for farms in the 50-99 size group since

Table 8. Per cent distribution of farms over 20 acres in size, Iowa Census years 1880-1940

<table>
<thead>
<tr>
<th>Size in acres</th>
<th>1880</th>
<th>1890</th>
<th>1900</th>
<th>1910</th>
<th>1920</th>
<th>1930</th>
<th>1940</th>
</tr>
</thead>
<tbody>
<tr>
<td>20- 49</td>
<td>15.1</td>
<td>9.4</td>
<td>9.9</td>
<td>7.7</td>
<td>6.5</td>
<td>6.1</td>
<td>6.1</td>
</tr>
<tr>
<td>50- 99</td>
<td>32.5</td>
<td>27.2</td>
<td>22.9</td>
<td>19.0</td>
<td>17.8</td>
<td>16.1</td>
<td>16.3</td>
</tr>
<tr>
<td>100-174</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>39.5</td>
<td>42.4</td>
<td>42.5</td>
<td>41.9</td>
</tr>
<tr>
<td>175-259</td>
<td>52.9</td>
<td>61.9</td>
<td>65.7</td>
<td>19.8</td>
<td>20.6</td>
<td>21.4</td>
<td>21.1</td>
</tr>
<tr>
<td>250-499</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>12.7</td>
<td>11.8</td>
<td>12.8</td>
<td>15.3</td>
</tr>
<tr>
<td>500 &amp; over</td>
<td>1.5</td>
<td>1.6</td>
<td>1.5</td>
<td>1.3</td>
<td>1.0</td>
<td>1.1</td>
<td>1.3</td>
</tr>
<tr>
<td>All farms</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

aNo data available.
b100-499 inclusive.
Figure 4. Index of wholesale prices, United States, 1820-1940.

Figure 5. Index of farm prices, United States, 1920-1940.
the number of farms in each of the next two higher size groups increased. If the consolidation of a medium and small farm had been most frequent then the total number of those in the medium size groups would have decreased while the number in the large size groups would have increased.

The temporary increase in numbers of very small farms between 1890 and 1900 probably resulted from two or three factors. It may have been partly the result of the depression of the nineties. The number of subsistence and part-time farms tends to increase with depressions since families who are out of work avail themselves of the opportunity to produce their own food while accepting temporary or seasonal work which may be available. Depressions are probably more nearly expressed, however, in fluctuations in numbers of farms under 20 acres (see appendix Table B). It is also likely that the temporary spurt in number of farms in the group 20-49 acres resulted as small bobtail segments of the near-exhausted supply of public lands were converted into individual farms and later were absorbed by larger units.

Recent Patterns in Farm Size Adjustments

Numerous forces which have bearing on farm size have developed since 1920. Some of these forces have been opposite in effect and perhaps others have not had full opportunity to gain momentum. Nevertheless, some trends for the state as a whole are discernible.

Forces arresting change

There were two factors tending to temporarily arrest consolidation
and expansion of farms in the period 1920-40. These factors were drought and depression. The first depression, that of the early 1930's was relatively unimportant in checking expansion because of its short duration and because other stimuli to expansion were as yet unimportant.

The more severe depression along with the droughts of the early 1930's was undoubtedly a greater force in molding the pattern of adjustments and in acting as a resistance to expansion. A comparison of the 1935 census with that of 1930 and 1940 tends to bear this out. Although the five-year census is not strictly comparable with the decennial census, some reliability can be placed on the data for trends in farm size adjustments for farms of more than 20 acres in size and certainly for those of more than 50 acres in size.

There was very little change between the distribution of farms in these size groups for the period 1930-35. Farm operators generally considered themselves fortunate if they were able to maintain the existing unit. Of course drought or depression, or any other factors which force income to a low level, may in certain instances speed up farm consolidation. The consolidation of some farms can take place only if other operators leave the occupation either because they are forced to do so through competition within the industry or because they voluntarily turn to other alternatives. Many persons turned from farming to other alternatives in the Great Plains states during the 1930's simply because their incomes were low relative to other opportunities. This allowed a high degree of consolidation by remaining farmers. However, the combination of drought and depression did not open the way for as great a degree of consolidation in Iowa as a whole as held true elsewhere. Although many
farmers in Iowa did not have the capital to carry out any previously contemplated expansion, the largest proportion of them were able to maintain existing units. Expansion on the part of those who may have wished to rent additional land was less than it might have been due to the competition of tenants who were seeking a more favorable location after having passed through the prolonged drought in certain Great Plains states.

Of course some few individuals were financially able to take advantage of the low land prices and add to their holdings. Ownership of land by corporations reached a peak at this time yet most foreclosed farms were evidently maintained as individual units. Even if only farms of fifty acres and over are considered, no net consolidation seems to have taken place during the early thirties.

A material increase in the number of farms under twenty acres between 1930 and 1935 is indicated in appendix Table B. It is impossible to separate the proportion of this increase which might have arisen from the creation of new units from that which may have resulted from varying interpretations of a farm between different census years. However, it is possible that there was some increase in the number of small retirement and subsistence or part-time units during the early thirties. Town and city workers again turned to such units as a means of bolstering their low incomes or providing a livelihood in cases of unemployment. Also a large number of older farmers who might have otherwise moved to town or ceased farming altogether probably turned toward small semi-retirements which still brought in some income.
Long-run trends

Aside from the above mentioned temporary lulls in farm size adjustments the trend was definitely toward consolidation and larger units between 1920 and 1940. The average size of all farms over 19 acres in size increased from 165.3 acres in 1920 to 170.0 in 1930 and to 172.9 in 1940. Also as is indicated in Table 7, the number of farms in each of the size groups 20-49, 50-99 and 100-174 acres decreased from 1920 to 1930 and again from 1930 to 1940. The number in the group 175-259 increased between 1920 and 1930 but decreased in the 1930-40 period. On the other hand the number of farms falling in the groups 260-499 and 500 and over increased in each of the ten-year periods 1920-30 and 1930-40. The greatest percentage change for any one group was in the size range of 500 acres and over. The number of farms in this group increased by 28.2 per cent for the entire twenty years and by 20.9 per cent between 1930 and 1940. The decrease in the number of all farms over 19 acres was 5,222 for the twenty year period and 2,710 for the 1930-40 period.

It is evident that the rate of consolidation of farms was greater in the period 1930-40 than in the period 1920-30. This increase in the rate of consolidation took place in spite of the fact that for the state as a whole the tendency to adjust size was at least partially arrested during the depression and droughts of the early thirties. This means then that the rate of consolidation in the late thirties must have been considerably greater than that for the 1930-40 period taken as a whole. An examination of the 1935 census data tends to substantiate this belief.
that the number of families formed or farms through consolidation and
proportion common to both in Rome. One agricultural estimate implied
an entropy of around that consolidation of farms never reached the


By adding together a medium-sized or small farm
farms was 2.4 acres. These data could have resulted in large farms expanded
areas was only 2.5 between 1850 and 1940 while the decrease in the 100-250
medium-sized units since the decrease in the number of farms under 100
or large farms. 50% of medium-sized units have been abandoned by other

That the small farm has been consolidated with a medium-size
250 acres and an increase in number for all groups over 250 acres indicates
Groups. Instead, the decrease in the number of farms in all groups under
Groups 100-250 and 1/2-250 acres and a consolidated number in the larger size
the number of farms under 100 acres, an increase in the number of farms in the size
the small farm. If this had been true, the table would show a decrease in
these consolidations have not come about through the formation of


the five-year census (or even in the department census) is for very small farms.

that these figures are fairly representative of the general effect in the
ation of 1250 may not be strictly comparable with that of 1940 in 1925
and cover was 25 per cent for the five-year period. Although the smaller-
the corresponding figure for the number of farms of 35 acres
or 25 per cent less than that shown by the 1925 census (see appendix)

The number of farms of 25 acres and over as indicated by the 1940 census

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solidations was obviously much less than this figure. The consolidation
of farms totaled only about 2.5 per cent for the entire five year period,
1935-40, or an average of .5 per cent per year if only farms over forty-
nine acres in size are considered. The rate of consolidations was 3.2
per cent for the 1935-40 period or .6 per cent per year if all farms
over nineteen acres in size are included. The absolute decrease in the
five years, 1935-40, was 1,134 per year if only farms of fifty acres
and over are considered and 1,296 if all farms of twenty acres and over
are considered. For the 1920-30 period consolidations of farms of 20
acres and over averaged .12 per cent per year and for the 1930-40 period
the average was .16 per cent per year.

Pattern of Change by Type-of-farming Areas

An examination of farm size changes for the state as a whole obscures
part of the adjustments which have been taking place. An increase in
one area tends to be cancelled out by a decrease in another area. An
examination of size adjustments by type-of-farming areas partially eliminates
this difficulty. The type-of-farming areas are not homogeneous enough
to eliminate all such opposing trends but such a breakdown of the state
is of some aid in this respect.

Northeast dairy area

Less change in farm size has taken place in the Northeast Dairy
area over the past two decades than in any other area of the state.
Even then, the small change which has taken place tended to maintain or
slightly increase the number of medium-sized farms. As a matter of
fact there was no net consolidation of farms between 1930 and 1940. The
total number of farms over nineteen acres in size in the area for 1940

Table 9. Number and percentage distribution of
farms by size groups, Northeast Dairy area
1920, 1930 and 1940

<table>
<thead>
<tr>
<th>Size group in acres</th>
<th>1920</th>
<th>1930</th>
<th>1940</th>
<th>Per cent distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-49</td>
<td>2384</td>
<td>2185</td>
<td>2181</td>
<td>6.0  5.6  5.6</td>
</tr>
<tr>
<td>50-99</td>
<td>6700</td>
<td>6157</td>
<td>6416</td>
<td>17.0 13.9 16.4</td>
</tr>
<tr>
<td>100-174</td>
<td>17146</td>
<td>17156</td>
<td>17149</td>
<td>43.7 44.4 43.3</td>
</tr>
<tr>
<td>175-299</td>
<td>8556</td>
<td>9361</td>
<td>8574</td>
<td>21.7 22.2 22.2</td>
</tr>
<tr>
<td>250-499</td>
<td>4296</td>
<td>4506</td>
<td>4401</td>
<td>10.9 11.6 11.2</td>
</tr>
<tr>
<td>500 &amp; over</td>
<td>290</td>
<td>285</td>
<td>333</td>
<td>0.7  0.7  0.8</td>
</tr>
<tr>
<td>All farms over 19</td>
<td>39341</td>
<td>38928</td>
<td>39164</td>
<td>100.0 100.0 100.0</td>
</tr>
<tr>
<td>All farms over 49</td>
<td>36987</td>
<td>36745</td>
<td>36983</td>
<td></td>
</tr>
</tbody>
</table>

was 39,154 as compared to 38,928 and 39,341 for 1930 and 1920 respectively.
A better comparison is made by considering only numbers of farms over forty-
ine acres since this mainly excludes subsistence, part-time or retirement
farms. As Table 9 indicates there have been practically no consolidations
even in these groups. The number of medium-sized farms (100-174 and
175-259 acres) has been especially well maintained. The tendency has not
been toward greater inequality in size of operating units.
Also, the number of farms in the size group 50-99 acres, although decreasing
the 20-40 acres group over the entire 20-year period, 1930-40 (Table 10).

<table>
<thead>
<tr>
<th>Year</th>
<th>20-40 Acres</th>
<th>50-99 Acres</th>
<th>100 Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>1930</td>
<td>2,567</td>
<td>763</td>
<td>470</td>
</tr>
<tr>
<td>1931</td>
<td>2,607</td>
<td>693</td>
<td>480</td>
</tr>
<tr>
<td>1932</td>
<td>2,647</td>
<td>623</td>
<td>490</td>
</tr>
<tr>
<td>1933</td>
<td>2,697</td>
<td>553</td>
<td>470</td>
</tr>
<tr>
<td>1934</td>
<td>2,747</td>
<td>483</td>
<td>460</td>
</tr>
<tr>
<td>1935</td>
<td>2,797</td>
<td>413</td>
<td>450</td>
</tr>
<tr>
<td>1936</td>
<td>2,847</td>
<td>343</td>
<td>440</td>
</tr>
<tr>
<td>1937</td>
<td>2,897</td>
<td>273</td>
<td>430</td>
</tr>
<tr>
<td>1938</td>
<td>2,947</td>
<td>203</td>
<td>420</td>
</tr>
<tr>
<td>1939</td>
<td>2,997</td>
<td>133</td>
<td>410</td>
</tr>
<tr>
<td>1940</td>
<td>3,047</td>
<td>63</td>
<td>400</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>1930</th>
<th>1931</th>
<th>1932</th>
<th>1933</th>
<th>1934</th>
<th>1935</th>
<th>1936</th>
<th>1937</th>
<th>1938</th>
<th>1939</th>
<th>1940</th>
</tr>
</thead>
<tbody>
<tr>
<td>50-99 Acres</td>
<td>740</td>
<td>760</td>
<td>780</td>
<td>800</td>
<td>820</td>
<td>840</td>
<td>860</td>
<td>880</td>
<td>900</td>
<td>920</td>
<td>940</td>
</tr>
<tr>
<td>100 Acres</td>
<td>570</td>
<td>550</td>
<td>530</td>
<td>510</td>
<td>490</td>
<td>470</td>
<td>450</td>
<td>430</td>
<td>410</td>
<td>390</td>
<td>370</td>
</tr>
</tbody>
</table>

Table 10. Number and percentage distribution of

Cash Grain Acres 1930, 1931, 1932, 1933, 1934, and 1940

Investor as a source of Income.

Investor's income is dependent upon the land to produce crops and where cash grain is important to

Investor's income is dependent upon the land to produce crops and where cash grain is important to

the region. A high proportion of the land is farmed for the same reasons the region has been

the region. A high proportion of the land is farmed for the same reasons the region has been

the region. A high proportion of the land is farmed for the same reasons the region has been

Although some have taken place, the number of complaints in

Cash Grain Acres

116
from 1920 to 1930, increased from 1930 to 1940. The increase in numbers for the small group probably represents an increase in the number of semi-retirement units and specialty units. The decrease in the total number of farms of twenty acres and over was 408 for the period 1930-40 while the decrease in the number of farms fifty acres and over was 466.

The trend which did take place was mostly in the direction of larger units. The only decreases in numbers took place in the 100-174 and the 175-259 acre groups. The 260-499 acre group made a slight increase while the 500 and over acre group made a relatively large increase. The fact that, although the number of farms in the smaller size groups increased, there was a net decrease in the number of all farms points to a net consolidation and expansion in acreage for all farms.

Western Livestock area

The Western Livestock area displays a trend which might have been expected in the Cash Grain area (Table 11). Although the changes were in favor of medium-sized and moderately large farms from 1920 to 1930, the shift was definitely toward larger farms in the 1930-40 period. Consolidations are evidenced in that the number of farms over forty-nine acres in 1940 was 1068 fewer than in 1930 and 741 less than in 1920. The corresponding figures for all farms of over nineteen acres are 1,116 and 923. Shifts out of the 50-99 and 100-174 groups and up into the next larger group are evidenced in Table 11. The number of farms in the
Table 11. Number and percentage distribution of farms by size groups Western Livestock area. 1920, 1930 and 1940

<table>
<thead>
<tr>
<th>Size group</th>
<th>1920</th>
<th>1930</th>
<th>1940</th>
<th>1920</th>
<th>1930</th>
<th>1940</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-49</td>
<td>2158</td>
<td>2111</td>
<td>1962</td>
<td>4.9</td>
<td>4.7</td>
<td>4.5</td>
</tr>
<tr>
<td>50-99</td>
<td>6315</td>
<td>6225</td>
<td>5983</td>
<td>15.4</td>
<td>14.0</td>
<td>15.8</td>
</tr>
<tr>
<td>100-174</td>
<td>19118</td>
<td>19473</td>
<td>18657</td>
<td>43.1</td>
<td>43.6</td>
<td>43.1</td>
</tr>
<tr>
<td>175-259</td>
<td>9645</td>
<td>9883</td>
<td>9460</td>
<td>21.6</td>
<td>22.2</td>
<td>21.9</td>
</tr>
<tr>
<td>260-499</td>
<td>6071</td>
<td>6400</td>
<td>6635</td>
<td>15.7</td>
<td>14.4</td>
<td>15.5</td>
</tr>
<tr>
<td>500 &amp; over</td>
<td>486</td>
<td>489</td>
<td>670</td>
<td>1.1</td>
<td>1.1</td>
<td>1.5</td>
</tr>
</tbody>
</table>

All farms over 19 acres:

<table>
<thead>
<tr>
<th>19 acres</th>
<th>44391</th>
<th>44694</th>
<th>43368</th>
<th>100.0</th>
<th>100.0</th>
<th>100.0</th>
</tr>
</thead>
</table>

All farms over 49 acres:

<table>
<thead>
<tr>
<th>49 acres</th>
<th>43138</th>
<th>42483</th>
<th>41395</th>
<th>--</th>
<th>--</th>
<th>--</th>
</tr>
</thead>
</table>

500 and over group increased from 489 in 1930 to 670 in 1940 or by 37 per cent.

Southern Pasture area

Farm size adjustments in the Southern Pasture area parallel those of the Western Livestock area. The number of farms over forty-nine acres in size decreased by 870 for the period 1930-40 and by 1,783 in the entire 1920-40 period. The decrease for all farms over nineteen acres in size was 1,115 for the period 1930-40 and 2,497 for the 1920-40 period. As Table 12 indicates, the noticeable trend was away from the small and medium unit and toward the moderately large unit. This area is again
Table 12. Number and percentage distribution of farms by size groups
Southern Pasture area, 1920, 1930 and 1940

<table>
<thead>
<tr>
<th>Size group</th>
<th>Number</th>
<th></th>
<th></th>
<th>Per cent</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1920</td>
<td>1930</td>
<td>1940</td>
<td></td>
<td>1920</td>
<td>1930</td>
</tr>
<tr>
<td>20-49</td>
<td>3365</td>
<td>2995</td>
<td>3952</td>
<td></td>
<td>8.9</td>
<td>6.2</td>
</tr>
<tr>
<td>50-99</td>
<td>8390</td>
<td>7267</td>
<td>7017</td>
<td></td>
<td>22.1</td>
<td>19.6</td>
</tr>
<tr>
<td>100-174</td>
<td>14697</td>
<td>13874</td>
<td>13126</td>
<td></td>
<td>38.4</td>
<td>37.6</td>
</tr>
<tr>
<td>175-259</td>
<td>6962</td>
<td>7173</td>
<td>6911</td>
<td></td>
<td>18.5</td>
<td>19.8</td>
</tr>
<tr>
<td>260-499</td>
<td>4658</td>
<td>4625</td>
<td>4774</td>
<td></td>
<td>10.9</td>
<td>12.4</td>
</tr>
<tr>
<td>500 &amp; over</td>
<td>531</td>
<td>807</td>
<td>716</td>
<td></td>
<td>1.4</td>
<td>2.2</td>
</tr>
</tbody>
</table>

All farms over

| 19 acres | 57993 | 38611 | 35496 | | 100.0 | 100.0 | 100.0 |
| 49 acres | 34632 | 33416 | 32546 | | -- | -- | -- |

one in which a minimum of farm size increase might be expected as a result of mechanization. A smaller cultivatable acreage per farm, rough lands and small and irregularly shaped fields should make mechanization a force of less importance. Yet the adjustments in farm size were again greater than for more level areas of the state.

**Eastern Livestock area**

Adjustments in farm size have also taken place in the Eastern Livestock area. Again the trend was in the direction of consolidation and larger farms. The number of farms in 1940 was less than that of either 1920 or 1930. The total number of farms of fifty acres and over in size decreased
When extensive and the eastern type have not been as great for the stage as a whole throughout the entire period. Apparently there have been some shifts toward larger figures for the recent percentage in farm size in the region.

Reasons for Recent Per cent of Change

As is noted in Table 13, the shifts were out of the size range 20-100 acres and into the larger range. Figures are 1.76% and 7.9% for a decade of twenty years and over are highlighted. By 1.629% from 1920 to 1940 and by 2.88% from 1950 to 1960.

Table 12. Per cent of total farm acreage in 1860

<table>
<thead>
<tr>
<th>Year</th>
<th>20.0</th>
<th>25.0</th>
<th>30.0</th>
<th>35.0</th>
<th>40.0</th>
<th>45.0</th>
<th>50.0</th>
<th>55.0</th>
<th>60.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Farm Acreage</td>
<td>360</td>
<td>568</td>
<td>768</td>
<td>968</td>
<td>1168</td>
<td>1368</td>
<td>1568</td>
<td>1768</td>
<td>1968</td>
</tr>
</tbody>
</table>

Table 13. Number and percentage distribution of farms by size groups. 1860, 1920, 1930, and 1940.
Effect of mechanization

An over-all force tending to bring about or make possible expansion during the periods under consideration was mechanization. The number of tractors on farms in Iowa increased from twenty thousand to thirty-seven thousand from 1925 to 1930 and to 124 thousand in 1940 (38). Similar increases in the number of other labor-saving machines have come about. This mechanization encourages larger units for three important reasons: (1) It makes possible the cultivation of a greater acreage with a given supply of family labor, (2) It results in fairly high fixed costs for the small unit with lower costs for the large unit, and (3) The tractor along with the truck eases the problem of traveling to distant units which may be operated in conjunction with the original unit.

Even though mechanization encourages operations on a greater scale for the reasons cited, it does not always force small-scale operators from their farm. It will diminish the income of the small-scale operator only if it results in an increased acreage and/or production of the crop and thus brings about a lower price for the commodities affected. Or it may force the small-scale operator from his farm only if it gives the large-scale operator a cost advantage so that he can pay higher rent or a greater price for the land. These points have been discussed in considerable detail in an earlier section of this study. However, it does not seem likely that mechanization alone has forced consolidation in either of the two respects mentioned above as far as Iowa is concerned.
Mechanization has resulted in some farm size expansion simply because it allows the labor of one family to accomplish more. For this reason consolidation has taken place not because mechanization results in a lower income for the small operator and thus forces him from the farm, but indirectly as a nearby neighbor, who has the tractor and equipment necessary for the operation of additional land, is in a favorable bargaining position to acquire the unit in question. The fact that a majority of the rented farms in Iowa are operated under a crop-share lease tends to nullify the advantage which the large-scale operator might have in respect to costs and hence in his ability to pay rents.

Even then, not all families look upon the tractor and the accompanying high-capacity machines as a means of increasing the acres operated by the family. Often the labor-saving equipment has been used to offset a family member who has left the farm or to displace the hired labor which would otherwise be required.

The consolidation of farms has not kept pace with the degree of mechanization in Iowa. Mechanization as a factor causing expansion in the size of farms has been over-emphasized. Mechanization in Iowa should more properly be looked upon as making possible larger-scale operations when the opportunity for such has been opened by other forces.

The comparisons of farm size adjustments between type-of-farming areas within the state further emphasize the fact that mechanization as a force in farm size adjustment has been over-emphasized. Increases in farm size have been less in the level central area than in the rougher western and
southern parts of the state, areas in which cash grain is less important relative to other sources of income. Further, the Northeast Dairy area, which is comparable to the Southern Pasture area in topography, does not show like trends. The explanations are not to be found in topography and mechanization as such. The use of labor-saving equipment makes possible the cultivation of more acres per farm but the additional land must be available first. Additional land will be available for expansion on the part of some operators only if and as units are given up by others. Farming will be given up by operators either because (1) they voluntarily forsake the industry for more promising alternatives elsewhere, (2) they are forced to do so because others can outbid them in terms of land rents and prices or (3) others have a special "pull" in renting the land. The first of these, voluntary abandonment, may come about either because returns in agriculture are low or because incomes elsewhere are high. If income from farming is low, remaining operators may expand as additional land is available not merely for the greater income forthcoming from lower unit costs but because of the greater returns from a larger volume of business.

**Low income forces**

One factor alone has probably been more important than mechanization in molding farm size adjustments. This factor is the level of farm income as affected by any force whatsoever. The Southern Pasture area has long been the low-income area of the state. Likewise the rougher sections of
the Western Livestock area have had low incomes as compared to other areas. Parts of both of these areas were especially hard-hit by the droughts of the 1930's. Furthermore, the great depression added burden to the existing income problems in these areas. An examination of farm size changes county by county within the two areas further substantiates the belief that the level of farm income is crucial in bringing about adjustments. The counties with the greatest proportion of rough land or those affected most severely by the droughts showed the greatest upward shift in farm size.

Table 16. Changes in number of farms over 49 acres, 1930-40, by type-of-farming areas

<table>
<thead>
<tr>
<th>Area</th>
<th>Change in number of farms</th>
<th>Area decrease as per cent of state decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>over 49 acres in size</td>
<td>1930-40</td>
</tr>
<tr>
<td>Number</td>
<td>Per cent</td>
<td></td>
</tr>
<tr>
<td>Northeast Dairy</td>
<td>433</td>
<td>.5</td>
</tr>
<tr>
<td>Cash Grain</td>
<td>-466</td>
<td>-1.3</td>
</tr>
<tr>
<td>Western Livestock</td>
<td>-1088</td>
<td>-2.6</td>
</tr>
<tr>
<td>Southern Pasture</td>
<td>-870</td>
<td>-2.5</td>
</tr>
<tr>
<td>Eastern Livestock</td>
<td>-349</td>
<td>-.9</td>
</tr>
</tbody>
</table>

*Net increase in Northeast Dairy area. The total for the other four areas exceeds 100.0 per cent since part of the consolidations were cancelled by the increase in the dairy area when the state average is considered.

In contrast, farm income in the Northeast Dairy area has been somewhat more stable than that of other areas. The price of dairy products remained more favorable than other farm prices during the 1930's. The droughts were not so severe. This greater stability in farm income is probably expressed in a greater stability of farm size. The fact that
fewer individuals' incomes fall to the distress level means that fewer persons forsake farming to move into other alternatives. This in turn means that fewer farms can consolidate and expand.

Farm tenure and size adjustments

Another factor important in molding farm size adjustments is farm tenure. This force has evidently tended to partially offset mechanization in the Cash Grain area relative to farm size adjustments. On the other hand it has augmented low income as a force in bringing about adjustments in the Southern Pasture and Western Livestock areas.

Aside from a temporary reversal during the depression, the trend in number of full-owned farms in some counties of the Cash Grain area has been upward. Conversely, the number of full-owned farms has been on the decline especially in some of the hilly counties of western and southern Iowa. An examination of Table 15 suggests some relationship between changes in farm ownership and changes in farm size. In general an increase in the number of full-owned farms was accompanied by a decrease in the average farm size between 1920 and 1940. Increases in farm size accompanied decreases in the number of owner-operated farms.

This relationship centers around two things: (1) capital available and (2) the stability of tenure. The operator of a newly acquired owned farm is certain of long-term tenure. His organization of the farm is long-run in nature. He is able to intensify operations and fully utilize feeds and labor by expanding in the direction of livestock enter-
Table 15. Relationship of changes in number of owned farms and average farm size by counties, Iowa, 1920 to 1940

<table>
<thead>
<tr>
<th>Counties grouped according to per cent change in farm size</th>
<th>Average per cent change in number of owned farms</th>
<th>Average per cent change in farm size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase of 5 per cent or more</td>
<td>-18</td>
<td>10</td>
</tr>
<tr>
<td>Increase of 1-4 per cent</td>
<td>-11</td>
<td>2</td>
</tr>
<tr>
<td>Decrease of 0-3 per cent</td>
<td>2</td>
<td>-1</td>
</tr>
<tr>
<td>Decrease of 4 per cent or more</td>
<td>7</td>
<td>-5</td>
</tr>
</tbody>
</table>

Coefficient of correlation between per cent change in farm size and per cent change in number owned farms of 0.6557 significant at 1 per cent level of probability.

prices. This is possible since his security of tenure now makes profitable the erection of buildings and equipment for livestock. If labor is his limiting factor then this intensive expansion (livestock) may necessitate an extensive contraction (acres) as he assumes ownership of a farm. If capital is his limiting factor then the down payment on the farm plus the greater investment in livestock and equipment may necessitate the operation of fewer acres. Too, once he is certain of his stay on the farm expansion in livestock may occasion less uncertainty than investing additional capital in land. The turnover of capital invested in land is slower than that invested in livestock and returns are subject to the tide of price fluctuations over longer periods.

The owner-tenant may well react in the opposite direction especially if he is operating under a short-term lease and with no certainty as to future tenancy. He can not be certain when he will be
forced to move and it is likely that he will receive no compensation for permanent or unexhausted improvements if he does have to move. Accordingly, his livestock enterprise will be held in check relative to that of the owner. For this reason, and if both his available labor and capital allow, he is likely to operate more acres than he did as an owner. Too, he may take this means of supplanting his income since it does not necessitate a permanent and non-reclaimable investment should he be forced to move.

One additional group of farmers may turn to an even greater farm acreage than the full tenant. This is the part-owner group of operators. Included at one extreme of this group is the new owner who is not entirely limited by either capital or labor. His security of tenure may allow intensive livestock operations but at the same time the availability of resources allows him to operate a larger unit composed of both owned and rented lands. At the other extreme of this group is the new owner who has enough capital to buy a small acreage and the normal equipment but not enough capital to own and fully stock an adequate unit. Thus in order to maintain or augment income he will operate not only the owned unit but also an additional rented tract. This tendency is facilitated by the tractor and labor-saving equipment which allows a given amount of labor to accomplish more and by the truck which makes possible the operation of more distant tracts.

That size of farm is influenced by shifts between ownership and tenancy is also suggested by Table 18. Part-owner farms are larger than
tenant farms, which in turn are larger than full-owned farms.

Table 16. Average size of farm by tenure groups, Iowa, for specified years

<table>
<thead>
<tr>
<th>Year</th>
<th>All owners</th>
<th>Farm tenure</th>
<th>Part owners</th>
<th>All tenants</th>
<th>Managers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>146.1</td>
<td>139.3</td>
<td>163.5</td>
<td>166.8</td>
<td>228.3</td>
</tr>
<tr>
<td>1930</td>
<td>147.7</td>
<td>139.5</td>
<td>203.8</td>
<td>168.3</td>
<td>246.2</td>
</tr>
<tr>
<td>1940</td>
<td>151.3</td>
<td>151.6</td>
<td>229.0</td>
<td>168.0</td>
<td>298.5</td>
</tr>
</tbody>
</table>

Table 16 has further significance. It indicates that it has not been the full-owned farm which has increased in size as has sometimes been implied. Neither has the size of the tenant farm increased appreciably. It is the unit operated by the part-owner or the manager which has shown a very definite trend in the direction of larger size. Table 16 suggests that the typical consolidation has not been that of two rented farms. Instead it has been the consolidation of a rented and an owned farm which thus results in a larger part-owned farm.

Change or lack of change in size of tenant-operated farms is largely molded by the size of farms available. As long as the typical farm to be rented is 160 acres the modal size of the tenant farm will be so determined. If all absentee-owned farms over 80 acres were sold to owner-operators the size of the tenant unit would decrease accordingly. Were all under 260 acres acquired by owner-operators the change would be in the opposite direction. The tenant may occasionally rent an additional unit but he does not enjoy the same advantage here as does the owner.

1The owner who is able to rent additional land then becomes a part-owner.
Often he will not have been in the community as long and thus may not have first knowledge of or first opportunity for a farm in which occupancy of buildings is not a requisite. Even though he be a competent farmer, the very fact that his stay in the neighborhood is less certain than for an owner of comparable efficiency puts him at a disadvantage. Further, landlords customarily prefer that any buildings be occupied. This condition is best met by the owner who has a volume of business great enough to merit the hiring of a married man. Once the tenant farmer has acquired enough capital to hire a year-round man who might occupy a second set of buildings he often purchases and moves to a smaller unit of his own.

Prospective Adjustments in Farm Size

An examination of assessors' reports (38) would suggest that farm consolidations and increases in size since 1940 have fairly well paralleled the 1930-40 pattern. The greatest increases in average farm size have come especially in the Southern Pasture area. This might be expected as many inadequate and low income units were left in favor of more attractive incomes elsewhere. The abandonment in turn gave some operators in the Southern Pasture area, where labor is not as fully utilized as elsewhere, a chance to expand their operations. Of course farm size adjustments have been hampered by wartime shortages. The tight labor situation and the limited amount of new machinery have tended to check expansion. This is especially true in those areas where labor was already being fully utilized.
The high level of income resulting from wartime prices may accelerate the tendency toward acreage expansion in the immediate post-war period when critical resources are again freely available on the market. Indications are that many farms will be financially able to purchase additional machines such as tractors, combines and cornpickers. Thus the possibilities of operating a larger unit even with a given labor supply will exist.

The very gradual increase in the number of farms above average size will probably continue. This tendency may also be especially strong if the economy remains in a state of prosperity. A high level of farm prices, a greater supply of labor and a minimum of uncertainty would serve as additional stimuli in farm size expansion. Further, a high level of industrial wages relative to agricultural prices might uproot additional operators who have remained on inadequate units.

Temporary forces

At the same time this latter factor may be offset entirely or in part by the willingness of a large number of returning servicemen and older farmers to operate small farms. A considerable number of older farmers who have stayed on during the war have indicated the desire to retire to small or part-time units. Many returning servicemen may have to operate

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1For data substantiating this belief see Heady, Earl O., "Farm Machinery Prospects" Iowa Farm Economist, May, 1944.
small units at the outset because of limited capital and because it may
be some time before they are able to spot more desirable units or are
able to increase their competitive position.

Gradual adjustments

Aside from any temporary spurt in the number of small units, the
gradual upward shift in farm size displayed in the past several years
will be prevalent in the future for two simple reasons: The potential
of larger units will be present because of the large number of tractors
and other labor-saving machines on the market. On the other hand, con-
solidations cannot take place until an additional unit is available in
the neighborhood. If the consolidation is to take place through the
addition of a rented farm to another rented farm or to an owned unit
the operator contemplating the consolidation must be able to locate a
farm within reasonable distance; he must wait until the present tenant
moves on his own accord or until the landlord becomes dissatisfied with
the present tenant and he must have greater pull or bargaining power
than another tenant who may be able to move onto the farm and occupy the
buildings. Similarly, the person who contemplates expansion through
the purchase of additional land must find a unit within a reasonable
distance, of a desirable size and at a reasonable price. If he has
the capital and machinery available for an additional 40 or 80 acres
it still may be impossible to carry out an expansion if only farms of
160 or 200 acres are being sold within a reasonable distance from his
original tract of land. This gradual increase in number of farms over average in size will also be safeguarded by the fact that the farm business is a one generation affair. As long as the single proprietorship remains the predominant form of ownership the typical beginning farmer will be limited in scale of operations to that which he can operate with a limited amount of capital.

**Modal units**

Some have predicted that in two or three decades the typical or modal size of farm will be 200 acres just as the 160 acre unit has been the modal unit in the past. It may be that the average size of farms in the state will be 200 acres in the future, although such will not be true even in three decades if the present rate of consolidation is continued. It is unlikely, however, that the modal size unit will be 200 acres. In order that the latter be possible it would be necessary, for example, that an equal number of 40 and 160 acre units be available. The number of single units of 40 acres each now existing is much less than the number of 160 acre units. Thus, in order to make possible expansion of most 160 acres to 200 acres some units which are now more than 40 acres would have to be divided into forties.\(^1\) This is not the typical manner in which land is sold. Most farms are sold as a unit and such will continue to be true as long as the number of buyers is

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\(^1\)A 200 acre unit can also be created by dividing, for example, a 380 acre unit into a 200 and a 120 acre unit. However, this adjustment is no more likely than the opposite mentioned above.
plentiful. For this reason the consolidation of the future will probably follow the pattern of the past. The unit of 160 acres will be combined with an 80, 40, 120 acre or other sized tract, depending upon which is available; the 240 acre unit will be combined with a 160, a 40 or even a 200 acre tract. Various combinations will likewise hold for other consolidations. Although an average farm size of 200 acres may come about in the next several decades, it is unlikely that a modal unit of this size will come about in a comparable period.

Although the trend outlined above seems most probable for the future, additional forces might also come into being. A move toward more ownership and less tenancy would encourage smaller units. This would be especially true were present tenants to become owners (in contrast to having owners add to their present holdings).

It is also possible that there may be some "unconsolidation" of farms in the future. During the depression years some older farmers retired, not by moving to town as is sometimes common, but by remaining on the farm and using only the building and lots. They did this simply because it was less costly than buying or renting a house in town. However, in order to retire on the farm it was necessary that the owner rent the farm land to a neighboring operator in case a tenant house was not included on the farm. This made possible the expansion of nearby farms. Should such remaining retired owners move to town after the war (which is now more nearly possible because of the high wartime farm income) the farm might again be operated as a single unit. Or as a greater number of
newly-retired farmers move to town after the war the possibility of
expansion by others will be less than if the retirement were to come
about through retention of the farmstead by the owner, as was the case
during the depression.

Implication of Farm Size Adjustments

The adjustments in farm size which have been taking place in Iowa
recently do not imperil the family-sized unit. The rate of consolidation
has been much less than many have supposed. The very gradual adjustment
which has been taking place has not revolutionized the size of the farm
unit in Iowa and will not do so in the near future. Of course, a rate
of consolidation equal to that of the late thirties (0.5 per cent per year
for all farms over 49 acres or 0.6 per cent for all over 19 acres) would
mean a considerable increase in the farm size over a long period of time.

Contrary to such views as that of Johnson (41) the stability in size
of the full-owned and tenant farms indicates that the beginning farmer
still has an opportunity to get started. Competition has not forced him
to take over a larger unit at the outset whether he be a tenant or owner.
This will continue to be so as long as capital accumulation passes through
its present evolution, as long as the individual proprietorship is
prevalent in agriculture and as long as outside forces such as depression,
drought and declining demands do not force large numbers of operators
from the land. 1 The level of land values and prices for working stock

1Depression results in a flow of people back to agriculture and the
creation of very small units. But aside from this a long period of
adverse income forces many operators off other farms thus paving the
way for expansion by others.
at any one time is more important than the number of acres per farm in limiting the size of the owned unit which can be started with a given amount of capital.

There can be no criticism of farm size adjustments which have taken place in those areas of extremely low income and in which adjustment has come about through consolidation of unproductive and undersized units. Part of the recent consolidation in Iowa has been of this sort. A larger part, however, has resulted from the consolidation of a small or medium-sized unit with one already medium or large in size.\(^1\) The first type, consolidation of two small units, usually comes about from the press of low incomes. The second type more often results from (1) mechanisation and the fact that the operator can accomplish more with a given amount of labor or (2) the fact that the operator has the necessary capital and bargaining power to acquire the additional unit.

Certainly the consolidation of units undersized in terms of income and labor use should be encouraged. Enlargement of farms means greater income because of lower costs, but more importantly because of the greater volume of business.

As has already been pointed out, consolidation of farms has its effect in fewer farm families, in the number of rural business establishments that can be maintained and in less support, both in terms of dollars and members, for such institutions as churches and schools. However, in case farm prices lag downward after the war, society must decide between two

\(^1\) This is denoted by the upward shift in farms by size groups as indicated in Table 10.
and what we have been doing so far... the role of the government's role in the economy is not just to provide a framework or set of rules by which businesses and individuals operate, but also to create an environment that encourages innovation and growth. This can be achieved through a variety of means, including investments in education and infrastructure, as well as through regulatory policies that promote competition and protect consumers.

However, there are also concerns about the potential negative effects of government intervention in the economy. Some argue that government regulations can stifle entrepreneurship and hinder economic growth, while others believe that they are necessary to ensure fair competition and protect consumers from undue harm.

In the end, the question of how much government should be involved in the economy is a complex one with no easy answers. It requires a careful balance of considerations, taking into account both the potential benefits and costs of government intervention. As the economy evolves and new challenges arise, it will be important to continuously reassess the role of government and adapt our policies accordingly.
tenant or part-owned farm. Accordingly, a shift from tenancy in the
direction of ownership should mean a smaller size for all farms and, at
the same time, a greater number of farms.
RELATIONSHIP OF FARM SIZE TO FARM INCOME

The number of acres in a farm is only one measure of size. This measure was the only one suited to the analysis of the problem under consideration in the preceding section. However, it does not always serve best when other problems of farm size are being studied.

Measures of Farm Size

The study of the relationship of farm income and related factors to farm size which is presented in this section necessitates the consideration of measures other than acres. The number of acres in a farm measures size extensively. It measures scale of operations satisfactorily for areas in which there exists a great deal of homogeneity as to soil type, topography and cropping pattern and where but little livestock is produced. Scale of operations can be increased, however, by adding livestock or crops which intensify operations on a given land area. A farm which specialises in livestock production may well be considered larger than another of like crop and total acres but which does not produce livestock.

Other common measures of farm size include total capital and work units. Although there is no one "best" measure of farm size either of these has an advantage over the acre measurement in that they include livestock and also take into consideration intensity of crop operations. Work units are used as the common denominator of size in most parts of
A work unit is considered as the amount of work performed by an average man in a ten-hour day. Hence, a dairy cow which requires 140 hours of labor per year constitutes 14 work units. An acre of corn which requires 16 hours constitutes 1.6 work units. The total size for any one farm in terms of work units is computed by (1) multiplying the numbers of each class of livestock or acres of each crop by the corresponding work unit conversion factor and (2) summing these products. The conversion factors used in this study are shown in appendix Table R. These are state averages and were used for all farms. For this reason they do not give a perfect measure of size. However, this disadvantage is far less than that associated with the acre measurement and an attempt is made to correct this weakness at a later point in the study. Whenever the term "size" is used in this section it refers to scale as measured in work units. Some comparisons between size as measured in work units and size in terms of acres are made in a later part of this study. In cases where size is being expressed in acres such will be indicated.

Source of Data

The data which serve as the basis of this section were obtained in two random samples in Iowa. One of these surveys was taken in 1939 and includes 732 farms. The other was taken in 1942 and includes 510 farms.

1 For a further explanation of the sample and the sampling method employed see Jossen, Raymond J. Statistical Investigation of a Sample Survey for Obtaining Farm Facts. Iowa Agr. Exp. Sta. Bul. 304a (1943)

2 This sample originally included approximately 600 farms. These farms
The 1939 sample is satisfactorily representative. The 1942 sample, while less representative than that of 1939, is reasonably so.

It is fortunate that random data for these two years are available. Farm income comparisons under two levels of prices are thus possible. The 1939 data represent a situation under a near-average price level. The Iowa farm price index stood at 98 per cent of the 1910-14 level during this year. The year 1942 was one of moderately high prices. The level of all Iowa farm commodity prices averaged 170 per cent of the 1910-14 base in this year.

One particular difference between the 1939 and the 1942 surveys should be noted. The 1939 survey was taken at the close of the year and covered business transactions for the entire preceding twelve-month period. The 1942 survey was taken quarterly and each survey covered only a three-month period. For this reason the 1939 data probably include more memory bias (forgotten quantities) than do those of 1942 since the operator had to recollect business transactions and other figures for a twelve-month period in the former year as compared to a three-month period in the latter year.

Memory bias is not serious in the enumeration of such physical quantities as total acres in the farm, acres of each crop, number of cows milked, number of sows farrowed, amounts and kinds of labor used and other

(footnote continued)

represented a random sample stratified by areas of the state. Schedules on farm business were taken quarterly. However, due to the fact that one or more schedules were not obtained for some farms a yearly summary of all 900 was not possible. These omissions were only very infrequently due to refusals and were more often due to the fact that the operator was not at home when the enumerator called. The average number of acres per farm for the 1942 survey was only 14 or 6.1 per cent greater than for the 1939 survey.
such large and infrequent happenings throughout the year. It tends to
be greatest for quantities occurring frequently and in small amounts
such as certain income and expenditure items. Because of the difference
in method of enumeration the 1942 data may not be strictly comparable to
that of 1939 in cases where memory bias is an important factor.

A greater memory bias in 1939 than in 1942 is not a serious obstacle
in the larger part of this study since comparisons are not often made
between the two years. In some sections the data of only one year have
been used since it is apparent that similar relationships would hold for
the other year. In other cases the data of both years are used, not as
a comparison of the degree of relationship between variables in the two
years, but merely to indicate the nature of the relationship between
variables where it was felt that the data for two years served better
than did the data for one year. Direct comparisons are made between the
degree of relationship for the data of the two years mainly in one instance.
The degree of relationship between farm size and farm income in 1939 is
compared with that of 1942.

The data presented in this section are sample statistics. They
are not population parameters such as was true in the preceding section.
Hence inferences drawn as to population parameters are subject to the usual
sampling errors.

Average Farm Size

The average number of work units per farm for all farms in the state
was 345 in 1939 (Table 17). The average for the 1942 survey was 380. 10
Table 17. Average farm size in work units and acres by type-of-farming area, type of farm and tenure group, 1939 and 1942 surveys

<table>
<thead>
<tr>
<th>Year, area, type of farm and tenure group</th>
<th>Size in work units</th>
<th>Size in acres</th>
<th>Size in work units</th>
<th>Size in acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>1939 Survey</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northeast Dairy</td>
<td>374</td>
<td>108</td>
<td></td>
<td>165</td>
</tr>
<tr>
<td>Cash Grain</td>
<td>377</td>
<td>109</td>
<td></td>
<td>180</td>
</tr>
<tr>
<td>Western Livestock</td>
<td>372</td>
<td>108</td>
<td></td>
<td>193</td>
</tr>
<tr>
<td>Southern Pasture</td>
<td>288</td>
<td>78</td>
<td></td>
<td>171</td>
</tr>
<tr>
<td>Eastern Livestock</td>
<td>259</td>
<td>96</td>
<td></td>
<td>154</td>
</tr>
<tr>
<td>Type of farm*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial cattle feeding</td>
<td>652</td>
<td>189</td>
<td></td>
<td>282</td>
</tr>
<tr>
<td>Crop</td>
<td>334</td>
<td>94</td>
<td></td>
<td>196</td>
</tr>
<tr>
<td>Dairy and hog</td>
<td>588</td>
<td>104</td>
<td></td>
<td>149</td>
</tr>
<tr>
<td>Dual purpose and hogs</td>
<td>636</td>
<td>128</td>
<td></td>
<td>211</td>
</tr>
<tr>
<td>General</td>
<td>335</td>
<td>97</td>
<td></td>
<td>175</td>
</tr>
<tr>
<td>Hog</td>
<td>333</td>
<td>97</td>
<td></td>
<td>156</td>
</tr>
<tr>
<td>State average**</td>
<td>345</td>
<td>100</td>
<td></td>
<td>172</td>
</tr>
<tr>
<td>1942 Survey</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tenure group*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full owners</td>
<td>338</td>
<td>89</td>
<td></td>
<td>158</td>
</tr>
<tr>
<td>Part owners</td>
<td>581</td>
<td>156</td>
<td></td>
<td>289</td>
</tr>
<tr>
<td>Tenants</td>
<td>355</td>
<td>96</td>
<td></td>
<td>188</td>
</tr>
<tr>
<td>State average**</td>
<td>330</td>
<td>100</td>
<td></td>
<td>186</td>
</tr>
</tbody>
</table>

*Differences between work unit group means significant at the 1 per cent level of probability.

**Difference between work unit means for 1939 and 1942 significant at the 1 per cent level of probability.
per cent more than for 1938. These figures should not be exactly comparable since the 1938 survey was more representative than that of 1948. However, the difference between the survey data of the two years is quite similar to the true difference for all farms as computed from the crop acreages and livestock numbers published by the United States Department of Agriculture (78) for the two years.

**Type-of-farming area**

In Table 17, the average number of work units per farm reveals a somewhat different pattern of farm size than does acreage alone. The average number of acres per farm in the Cash Grain area and the Western livestock area is considerably greater than that of the other three areas. The average size in acres for the Southern Pasture area is only 1 per cent less than for the state average. However, a comparison of size in terms of work units shows no appreciable difference between the Northeast Dairy, Cash Grain and Western Livestock areas and only little difference for the Eastern Livestock area. On the other hand, the average size of farms for the Southern Pasture area, in terms of work units, was 22 per cent less.

---

1 Some might wonder that the average farm would produce so few work units in 335 days since a work unit supposedly amounts to the labor of a ten-hour day. However, when Sundays, stormy days and slack winter periods are taken into consideration the number of work units shown is probably not far out of line. Too, the labor requirements upon which these figures are based probably do not include all the farm and repair work necessary. This last fact does not invalidate the comparisons as long as each type of enterprise bears the correct relationship to others. The work units used in this study are not exactly comparable to the productive-man work units used for some other states.
than the state average and 26 per cent less than the average of the other
four areas. Most of the difference in size is removed between the four
areas first mentioned since the work unit standard accounts for the greater
intensity of operations in the Northeast Dairy and Eastern Livestock areas.
This standard lends greater emphasis to the inadequacy of the size of
many southern Iowa farms. A greater proportion of rough and non-tillable
land and lack of feed necessitates less intensive operations. A given
number of acres in the Southern Pasture area does not result in as great
a scale of operations as in any other one area of the state.

Farm types

A comparison of work units per farm shows little difference between
crop, dairy and hog, general, and hog farms.1 Again the differences in

1 Farms were classified in the following manner:

General or diversified farms: Those with no single source of income —
generally with three or more fairly important sources of income.

Crop farms: Crop sales equal to 30 per cent or more of the value of
all crops raised and also equal to more than 25 per cent of total
cash sales (includes the value of crops turned over to the landlord
for rent).

Hog farms: One litter of pigs raised for each 8 acres (or less) of
land in rotation.

Dairy and hog farms: One milk cow for each 16 (or fewer) acres of total
land in farm and butterfat production over 125 pounds per cow.

Dual purpose cattle and hog farms: One breeding cow (in opening in-
ventory) for each 16 (or fewer) acres of land and butterfat production
less than 125 pounds per cow. Also with beef sales of importance
comparable to butterfat sales.

Commercial cattle-feeding farms: Selling at least 30 cattle and buy-
ing at least two-thirds as many as sold.
size as expressed in acreage tend to be eliminated when livestock numbers are also included in scale of operation. The dual purpose and hog-type farm was 26 per cent greater in size than the average of all farms. Commercial cattle-feeding farms were 89 per cent greater. The dual purpose and hog-type farm, although using more labor than the average, was probably able to dovetail its enterprises in a manner which allowed more work units. Commercial cattle-feeding farms are large in every aspect; the number of acres per farm is greater than for the average farm and operations are carried out on a more intensive scale.  

Temure groups

A comparison of work units by tenure groups for 1942 displays the same ranking as does a comparison of acres for farms so grouped: The part-owned farm is largest while the full-owned farm is even smaller than the rented farm. However, part of the gap between the full-owned and rented farm is closed when the work units are used as the measure of size.

This shift in relative rank is accounted for by the fact that the work unit standard (1) accounts for livestock as well as farm acres and (2) accounts for the fact that some crops are more intensive than others or that some types of livestock add more to volume of business than does a like number of other animals. Again, these comparisons emphasise an advantage in using work units instead of acres in measuring size.

---

1In order that the terminology be kept as simple as possible in the remainder of the study "dairy and hog farms" will henceforth be indicated as "dairy farms", "dual purpose and hogs" as "dual purpose farms" and "commercial cattle-feeding" as "cattle feeding".
Correlation Between Income and Size

Net farm income was chosen as the measure of income in this analysis since it is more nearly a function of scale of operations than is net operator income. Net operator income varies on tenant farms with the type of lease and rental rates. Accordingly, in instances when both owners and renters are considered together the net operator income represents a composite of situations, the average of which fits neither group. Net farm income can be used satisfactorily to indicate the relationship of returns to size for comparisons by farming types, areas and other classifications. The tenant operator thus has some idea of the importance of size in each case. However, one comparison between net operator income on rented and tenant farms is made in this study since it is important that some idea of the relative returns of renting or owning farms of various sizes be had.

Net farm income as used in this study is the difference between total farm credits and total farm debits. Income from off-farm work and other outside sources is excluded. Interest payments have also been excluded as a cost since the surveys do not give an accurate accounting of all such payments. The tenant usually knows little about interest payments by the landlord even though he may be able to make a fair estimate as to taxes and other fixed expenses.

State averages

Table 18 shows the net returns for farms grouped according to size
The table below shows the per cent of the variance in net farm income.

<table>
<thead>
<tr>
<th>Year</th>
<th>1945</th>
<th>1946</th>
<th>1947</th>
<th>1948</th>
<th>1949</th>
</tr>
</thead>
<tbody>
<tr>
<td>1°9°</td>
<td>600</td>
<td>560</td>
<td>520</td>
<td>480</td>
<td>440</td>
</tr>
</tbody>
</table>

The figures for the fixed gains are 52°. The variance unexplained for 1949.

The corresponding figures for all years in the 1948 sample.

The table at top shows, 60° per cent of the variance in net farm income.

The figures are for 1949 and 1948 samples.

Table 15. Number, average size, and net farm income of farm units.
Table 19. Correlation of net farm income with size in work units by type-of-farming area, type of farm and tenure groups, 1939 and 1942 surveys

<table>
<thead>
<tr>
<th>Year, area, type of farm and tenure group</th>
<th>Correlation:Coefficient of determination</th>
<th>Probability</th>
<th>Fiducial limits of r at 5 per cent level of probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>All farms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1939*</td>
<td>.7106</td>
<td>.5050</td>
<td>.6726</td>
</tr>
<tr>
<td>1942*</td>
<td>.7246</td>
<td>.5249</td>
<td>.6799</td>
</tr>
<tr>
<td>Area (1939)*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northeast Dairy*</td>
<td>.7552</td>
<td>.5703</td>
<td>.6799</td>
</tr>
<tr>
<td>Cash Grain*</td>
<td>.6165</td>
<td>.5504</td>
<td>.6014</td>
</tr>
<tr>
<td>Western Livestock*</td>
<td>.7110</td>
<td>.5085</td>
<td>.6169</td>
</tr>
<tr>
<td>Southern Pasture*</td>
<td>.7363</td>
<td>.4821</td>
<td>.6506</td>
</tr>
<tr>
<td>Eastern Livestock*</td>
<td>.7683</td>
<td>.5911</td>
<td>.6963</td>
</tr>
<tr>
<td>Type of farm (1939)*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cattle-feeding*</td>
<td>.6464</td>
<td>.4178</td>
<td>.4186</td>
</tr>
<tr>
<td>Crop*</td>
<td>.7145</td>
<td>.5102</td>
<td>.5983</td>
</tr>
<tr>
<td>Dairy*</td>
<td>.6192</td>
<td>.4711</td>
<td>.5229</td>
</tr>
<tr>
<td>Dual-purpose*</td>
<td>.6224</td>
<td>.4871</td>
<td>.4770</td>
</tr>
<tr>
<td>General*</td>
<td>.6556</td>
<td>.4232</td>
<td>.5365</td>
</tr>
<tr>
<td>Hog*</td>
<td>.6430</td>
<td>.4154</td>
<td>.5349</td>
</tr>
<tr>
<td>Tenure (1942)*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full-owner*</td>
<td>.7495</td>
<td>.5618</td>
<td>.6644</td>
</tr>
<tr>
<td>Part-owner*</td>
<td>.6900</td>
<td>.4524</td>
<td>.5072</td>
</tr>
<tr>
<td>Tenant*</td>
<td>.7082</td>
<td>.5080</td>
<td>.6387</td>
</tr>
</tbody>
</table>

*Correlation coefficient significant at the 1 per cent level of probability.

**Differences between group correlations significant at the 1 per cent level of probability.

* Differences between group correlations non-significant at the 5 per cent level of probability.
It thus appears that no other one factor might be so closely associated with net farm income as is size.\(^1\)

This statement is a generalisation for all farms in the years studied. It does not mean that size is the most important factor on any one individual farm. Some farms, for example, might not increase income as much by expanding operations as by making other adjustments in their operations. An operator who is technically inefficient might increase income by the greatest amount if he were to curtail operations and improve efficiency. The operator who is technically efficient but is producing a product for which cost/price relationships are unfavorable would lose more only if he were to expand. He may actually increase income by contracting operations while shifting to more profitable enterprises. The correlation between income and size may even be negative in years of rapidly falling prices. These possibilities and others are not excluded by the statement that a major portion of the variance in farm income between farms was associated with farm size for the two samples studied.

As is indicated in Table 19, the correlation coefficient between net farm income and man work units was slightly greater in 1942 than in 1939. One might expect that in 1942, a year of high prices and lagging costs, farm size would be a more important factor affecting income. However, the differences between the correlation coefficients for the two years was not statistically significant. Scale of operations seems to have been as important in explaining variations in income in 1939 as in 1942. An additional unit of size added more to income in 1942 than in 1939 but

\(^1\)This statement refers to other factors which do not also include size.
a similar portion of the variance in income between farms was explained by farm size in the two years.

**Type-of-farming areas**

The correlation coefficients between size and net farm income for farms grouped by area are included in Table 19. Statistically there are no significant differences between these. Evidently size as an explanation of net farm income is as important in one part of the state as in others.

This last mentioned fact in itself is of economic significance. The smaller scale of operations in the Southern Pasture area relative to that of other areas was previously noted. The income of southern Iowa farms might best be put on a par with that of other areas by increasing the scale of operations. This would necessitate several major adjustments in the area. Size of operations might be enlarged through increased production of livestock and livestock products. This type of expansion would require the importation of much additional feed since the area normally has a feed deficit. Additional facilities for handling inshipments of grain and, in certain cases, the outshipments of livestock products might be required. Hence, expansion might in many cases best come about through an increased acreage per farm.

Income seemed to be most closely associated with size in the case of dairy and crop farms. This might be explained for crop farms since less skill is ordinarily required here than on a farm where livestock as well as crops is an important source of income. Losses from disease, pests
and other natural hazards generally vary less between farms in Iowa for
crops than for livestock. Size explained a greater proportion of the
variance in incomes for dairy farms than for any other type of farm studied.
Although there is a great variation in the production and profit per dairy
hard between all farms, this type of variation tends to be minimized
within the dairy-type group of farms. The fact that the herds within
this group of farms are more nearly on a comparable production level
means that a greater proportion of the variation between farms can be
explained by size and less by difference in technical efficiency.

Scale of operations explained a smaller proportion of the variance
in net farm income on cattle feeding farms than for any other type. The
reason for this centers partly on the fact that these farms typically
operate on a large scale. Very few medium-sized or small farms were
included in the sample of cattle-feeding farms. As is pointed out in
a later part of this study, the scatter diagram of income plotted against
size shows a greater dispersion for large farms than for medium or small
farms for all types of farms. Hence, it is likely that had the group of
cattle-feeding farms included more medium-sized or small farms, the
correlation between size and income would have been greater.\(^1\) Equally
or more important is the fact that there is more variation in types of

\(^1\)This statement does not mean that if a group of cattle-feeding farms
were selected so that a larger proportion of small farms were in-
cluded the correlation coefficient would be more nearly represent-
ative of the population. The correlation coefficient might be
increased by such a procedure but it would be less representative of
the population than the coefficient for the random sample.
The relationship between net farm income and the measured revenue is:

\[ \text{Net Farm Income} = \text{Revenue} \]
It might seem very queer to I
think you would be interested in the

To solve this, you would have to add a

and

The

The

The

To solve this, you would have to add a


This hypothesis is not demonstrated with the outcome

Errors greater than 1 indicate non-normality of the

Tests at the 1 per cent level of probability. These
go to test the hypotheses of concern, relevant to

All tables taken together.

Table 2 further suggested that this
genesis of mathematical models for
Table 20. Fiducial limits of average elasticities at the 1 per cent level of probability, 1939 and 1942 surveys

<table>
<thead>
<tr>
<th>Year, area, type of farm and tenure group</th>
<th>Fiducial limits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Upper</td>
</tr>
</tbody>
</table>

1939 Survey

<table>
<thead>
<tr>
<th>Area</th>
<th>Fiducial limits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Upper</td>
</tr>
<tr>
<td>Northeast Dairy</td>
<td>1.2721</td>
</tr>
<tr>
<td>Cash Grain</td>
<td>1.9506</td>
</tr>
<tr>
<td>Western Livestock</td>
<td>1.7680</td>
</tr>
<tr>
<td>Southern Pasture</td>
<td>1.3972</td>
</tr>
<tr>
<td>Eastern Livestock</td>
<td>1.4153</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of farm</th>
<th>Fiducial limits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Upper</td>
</tr>
<tr>
<td>Cattle-feeding</td>
<td>2.1200</td>
</tr>
<tr>
<td>Crop</td>
<td>1.3788</td>
</tr>
<tr>
<td>Dairy</td>
<td>1.4900</td>
</tr>
<tr>
<td>Dual-purpose</td>
<td>1.5028</td>
</tr>
<tr>
<td>General</td>
<td>1.2298</td>
</tr>
<tr>
<td>Hog</td>
<td>1.4277</td>
</tr>
</tbody>
</table>

1942 Survey

<table>
<thead>
<tr>
<th>Tenure</th>
<th>Fiducial limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner</td>
<td>1.2954</td>
</tr>
<tr>
<td>Part-owner</td>
<td>1.8854</td>
</tr>
<tr>
<td>Tenant</td>
<td>1.1274</td>
</tr>
</tbody>
</table>
acreage was increased by less than twice the original amount due to the discontinuity in the supply of these factors. However, since the upper limit was close to unity this case may only represent a sampling variation.

The procedure outlined above tests the hypothesis of constant returns to scale for the farms in each group. It might well be that although the function is most nearly linear for all farms taken together, the function could be different for small farms than for large farms. The inspection of the scatter diagram suggested constant returns to scale throughout each group. However, the distribution of variates about the line of regression was heteroscedastic. That is, the variation of individual farm incomes about the computed line of regression were not equal for the various intervals of size.

The scatter was quite uniform for the 0-750 range of work units per farm but varied widely for farms of greater size. The fact that the distribution of the variates was heteroscedastic in the manner mentioned is meaningful. The incomes of average or relatively small farms tend to vary within a fairly narrow limit. On the other hand there appears to be no modal income for larger farms. Incomes were either considerably above or below the regression line. Successful large farms are exceedingly so while the less successful do no better than for somewhat smaller units. There appears to be little or no in-between. The successful operators are cut out for the job and have the ability necessary for large

---

1This suggests that had the correlation analysis of Table 19 been one of a curvilinear relationship for the Cash Grain area the proportion of the variance in net farm income explained by size would have been greater than that indicated.
undertakings. The unsuccessful are just not "large scale operators" and might, in some instances, have incomes as large or larger were they to operate smaller units on an efficient basis.

Relationships of Other Measures of Size to Income and Work Units

Work units are not a perfect measure of farm size since they do not directly take into consideration the productivity of land or livestock. Two farms of like acres and livestock numbers will be shown as of the same size even if productivity of land and livestock is high on one farm and low on the other when work units are used to measure scale of operations. Actually the inputs of productive factors will be greater on the more productive farm since it will require more labor and other resources.

Addition of capital as a variable factor

This fact may be at least partially accounted for by the addition of capital as an independent variable. The greater value of the higher-producing land and livestock will account for the greater productivity and hence, roughly, for the differences in size not explained by work units alone. To get evidence on this point Table 21 has been computed. It indicates the increased variance in net farm income attributable to the inclusion of total capital in the analysis.

The correlations suggest that a significant proportion of the var-
Variance in net farm income was in practically all cases accounted for by the inclusion of total capital. Although work units alone explained 50.5 per cent of the variance in income between all farms in 1939, work units and total capital together explained 54.5 per cent. The corresponding figures for the 1942 sample are 52.5 and 61.0 per cent. Although there is some doubt in the cases of crop and dairy farms, somewhat similar significant increases in the variance of net farm income have been accounted for in all other groups of farms studied with the exception of cattle-feeding farms.

The values of $R^2$ in Table 21 may be looked upon as somewhat indicative of the degree of association between farm size and net farm income when that portion of farm size related to inherent productivity of land and livestock has also been considered. (In contrast to the figures of Table 19 which do not fully measure farm size since they do not account for the fact that either inputs of resources or output of commodities may be greater for land or livestock of relatively greater inherent productivity.) Not all of the increased variance in net farm income explained by the addition of total capital to the correlation analysis can be attributed to an accounting of size not expressed in the work unit standard. This can again be best illustrated by use of a hypothetical example: The inherent productivity of two separate tracts of land is such that the yield of corn on the first is 80 bushels and on the second 40 bushels. In terms of physical output, the scale of operations on the 80-bushel land is twice that of the 40-bushel land. In terms of physical inputs, the scale of operations on the 80-bushel land will be greater than that on the 40-bushel
Table 21. Correlation between net farm income and income estimated from work units \( (X_1) \) and total capital \( (X_2) \) *
1939 and 1942 surveys

<table>
<thead>
<tr>
<th>Year, area, type of farm and tenure group</th>
<th>Correlation coefficient of variance in farm income accounted for by adding capital to correlation analysis</th>
<th>Difference in proportion of variance in farm income accounted for by adding capital to correlation analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>All farms</td>
<td>.7390 .5450 .0400 63.78**</td>
<td></td>
</tr>
<tr>
<td>1939</td>
<td>.7321 .6101 .0852 110.80**</td>
<td></td>
</tr>
<tr>
<td>1942</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Areas (1939)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northeast Dairy</td>
<td>.8137 .6576 .0873 37.47**</td>
<td></td>
</tr>
<tr>
<td>Cash Grain</td>
<td>.6327 .3917 .0116 4.98*</td>
<td></td>
</tr>
<tr>
<td>Western Livestock</td>
<td>.7449 .5649 .0494 15.31**</td>
<td></td>
</tr>
<tr>
<td>Southern Pasture</td>
<td>.7607 .5723 .0522 9.27**</td>
<td></td>
</tr>
<tr>
<td>Eastern Livestock</td>
<td>.7944 .6264 .0355 14.96**</td>
<td></td>
</tr>
<tr>
<td>Type of farm (1939)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cattle-feeding</td>
<td>.8531 .4285 .0087 .52*</td>
<td></td>
</tr>
<tr>
<td>Crop</td>
<td>.7467 .5299 .0197 5.31*</td>
<td></td>
</tr>
<tr>
<td>Dairy</td>
<td>.8292 .6801 .0080 2.26*</td>
<td></td>
</tr>
<tr>
<td>Dual purpose</td>
<td>.7529 .5561 .1697 31.17**</td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>.6964 .4622 .0390 10.06**</td>
<td></td>
</tr>
<tr>
<td>Hog</td>
<td>.6886 .4696 .0562 18.75**</td>
<td></td>
</tr>
<tr>
<td>Tenure group (1942)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full owner</td>
<td>.7741 .5965 .0337 17.92**</td>
<td></td>
</tr>
<tr>
<td>Part-owner</td>
<td>.8023 .6307 .1885 25.06**</td>
<td></td>
</tr>
<tr>
<td>Tenant</td>
<td>.7649 .5815 .0785 4.33*</td>
<td></td>
</tr>
</tbody>
</table>

*All correlation coefficients significant at the 1 per cent level of probability.

**Difference between variance accounted for by simple correlation of Table 19 and multiple correlation of Table 21.

*Non-significant statistically.

*Significant at the 20 per cent level of probability.

*Significant at the 5 per cent level of probability.

**Significant at the 1 per cent level of probability.
land, although not twice as great. However, the value of the 60-bushel land may well be more than twice that of the 40-bushel land since costs per unit of output will not be twice as great. Thus the inclusion of total capital in the correlation analysis not only accounts for size not explained by work units but also relates to net farm income some other factors which are associated with size.

In most of the remaining parts of this section it has been necessary to use only one measure of farm size. The measure which has been used is work units. It is of course true that the number of work units per farm and the total capital employed are highly correlated. It might thus seem that one of these standards should serve as well as the other as a measure of farm size. This is not far from true, yet it appears that there are some advantages in using work units as the standard in cases where only one measure can be handled conveniently. The total capital investment does not always indicate the scale of physical operation accurately either in terms of input of productive resources or output of commodities. For example, one person might own 320 acres of land valued at $200 per acre on which little or no crop production has been carried on during the year while another person operates 160 acres valued at $150 per acre and on which intensive livestock or crop operations have been carried out. The use of capital as the measure of size would place the first of these two farms far above the second in regard to scale of operations while in terms of all inputs including land or in terms of output the second may actually be largest. There are other important reasons why work units may serve better than total capital. In two years of different price levels the
latter measure would indicate that the scale of operations was different
on a farm even though the input of productive factors or the output of
commodities were identical in the two years. This difficulty is not
encountered when work units are used as the measure of size. Too, manage-
ment is brought into consideration more by the work unit standard than by
total capital.

**Relationship of acres to income and work units**

The addition of acres as a variable in the correlation analysis did
not account for any significant portion of the remaining variance in net
farm income not explained by the two factors previously analyzed. It is
easy to see why this was true. The work unit standard accounts directly
for all crop land since acres of each crop are converted into work units.
It also accounts indirectly for all pasture land since the livestock numbers
are converted into work units.

Although such is not a physical necessity the number of acres per farm
is positively correlated with the number of work units per farm in Iowa.¹
A large number of work units per farm tends to be associated with a large
number of acres per farm (Table 22). This relationship springs from

¹The first part of this statement is true within certain limits. The
scale of operations can be increased by the production of more livestock
or more intensive crops on a given sized farm as well as by taking
on more acres. There is, however, a limit to the amount of livestock
or capital which can be used per acre of land. This ultimate physical
limitation has little meaning in Iowa since intensification has reached
this point on few if any farms.
basic principles of farm organization. The farm which increases the number of acres is confronted with the problem of a balanced utilization of resources and the most profitable disposal of crops. An increase in acres brings

Table 22. Relationships of acres and work units per farm, 1939 and 1942 surveys

<table>
<thead>
<tr>
<th>Size interval in work units</th>
<th>Average number of acres per farm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1939</td>
</tr>
<tr>
<td>0-149</td>
<td>60</td>
</tr>
<tr>
<td>150-299</td>
<td>128</td>
</tr>
<tr>
<td>300-449</td>
<td>188</td>
</tr>
<tr>
<td>450-599</td>
<td>236</td>
</tr>
<tr>
<td>600 &amp; over</td>
<td>360</td>
</tr>
<tr>
<td>Correlation coefficient</td>
<td>.7305*</td>
</tr>
</tbody>
</table>

*Significant at the 1 per cent level of probability.

about peaked seasonal labor and power requirements unless accompanied by livestock to fill in the slack periods. The livestock often represents one method of utilizing roughages produced in the rotation or in selling other feeds at a greater return. On the other hand, an operator who initiates an intensive expansion (greater livestock numbers) may find more extensive expansion (additional acres) is desirable in order that feed be available. This is especially necessary in the case of roughage-consuming livestock.

Should not the close relationship between acres and work units mean that the two measures are equally reliable in estimating net farm income? This would be true were work units and acres perfectly correlated. However,
this condition does not hold. Acres per farm explained only 53 per cent of the variance in work units per farm in 1939 and 51 per cent in 1942.

It is not the number of acres per farm alone but also the number and acres of each type of livestock and crop respectively which explains the aggregate size of the farm business.

The relationships outlined above should not be forgotten when farm size adjustments are being considered. Yet this is not always true. At one extreme is that group which especially worries about the acreage increase of some farms. They tend to forget that the remaining land area would support the original number of farms at the previous aggregate size were they smaller in acreage while greater in intensity of operations. For this reason, in attempting to find means of maintaining a maximum number of family farms, they often turn in the wrong direction. Representative of this is the suggestion that legislation limiting the number of acres per farm be enacted. As is indicated in other parts of this study the full-owned farm is smaller in acres but greater in intensity than the tenant farm. Thus, credit and tenure institutions which allow either more full-owned farms or greater security of tenure may in part be a more basic answer to the question at hand.

At the other extreme is the group suggesting that in a state such as Iowa operations on the present number of farms should be intensified to a much greater degree in order to increase the state's agriculture and make possible support of a greater number of people. This suggestion is more or less paralleled by the argument that an increase in number of farms should be brought about through a decrease in number of acres per farm,
this diminution to be offset by greater intensity of operations. The supporters of these views overlook the fact that some balance between intensive and extensive expansion (or contraction) is necessary. Further, there is a limit to which scale can be increased or maintained through a greater intensification of operations on all farms. The maximum amount of feed which can be produced would not allow a high degree of simultaneous intensification by all farms.

Farm Organization

A study of the relationship of farm size to farm income brings up the question of the operator's managerial ability. Is it that the most efficient operators are on the large units while the less efficient are small scale operators? Is it possible that the greater income of the large unit is a result of the operator's managerial and technical ability rather than size as such?

Were it possible to measure and rank the ability of farmers in a single index the answers to such questions would not be difficult to obtain. Techniques either simple or elaborate might be employed. However, no single objective measurements exists. The ability of the operator makes its appearance in several ways. It may be particularly manifested in the over-all selection and combination of enterprises; in technical efficiency and hence production costs; in organization of productive resources; in adjustments to price situations or in other manners. One of these factors, selection and combination of enterprises, has already been taken into consideration. This is true since the
correlation of income to farm size was analyzed by types of farms.

Organization of business

Additional comparisons which will give an indication of whether or not the relationship between income and farm size is confounded with the ability of the manager are possible from the data available. Table 25 shows the proportion of total work units made up of crops and livestock in both 1939 and 1942. There were no striking differences in the relative importance of livestock or crops between size groups in either of the two years.

Table 25. Distribution of total work units between crops and livestock, 1939 and 1942 surveys

<table>
<thead>
<tr>
<th>Size interval in work units</th>
<th>Number</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Livestock: 1939, 1942</td>
<td>Crops: 1939, 1942</td>
</tr>
<tr>
<td></td>
<td>Livestock: 1939, 1942</td>
<td>Crops: 1939, 1942</td>
</tr>
<tr>
<td>0-149</td>
<td>61.8</td>
<td>64.6</td>
</tr>
<tr>
<td>150-299</td>
<td>145.1</td>
<td>147.0</td>
</tr>
<tr>
<td>300-449</td>
<td>226.6</td>
<td>235.7</td>
</tr>
<tr>
<td>450-599</td>
<td>323.0</td>
<td>306.5</td>
</tr>
<tr>
<td>600 &amp; over</td>
<td>509.3</td>
<td>492.0</td>
</tr>
</tbody>
</table>

Crop and livestock returns

Two efficiency factors which indicate both managerial and technical ability are the gross value of crops per crop acre and the returns per $100 feed fed. These two are, in general, the most important over-all efficiency factors in the crop-livestock economy of Iowa's agriculture.
They are dependent not only on rates of production but also on whether or not crops and livestock have been combined in the most profitable manner (in light of existing price relationships). Table 24 indicates the gross value of crops per crop acre and the returns per $100 feed fed by size groups for 1939.

Table 24. Average gross value of crops per acre and returns per $100 feed fed, 1939 survey

<table>
<thead>
<tr>
<th>Size interval in work units</th>
<th>Gross value of crops per crop acre (dollars)</th>
<th>Returns per $100 feed fed (dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-149</td>
<td>15</td>
<td>194</td>
</tr>
<tr>
<td>150-299</td>
<td>15</td>
<td>177</td>
</tr>
<tr>
<td>300-449</td>
<td>16</td>
<td>165</td>
</tr>
<tr>
<td>450-599</td>
<td>17</td>
<td>170</td>
</tr>
<tr>
<td>600 &amp; over</td>
<td>18</td>
<td>161</td>
</tr>
</tbody>
</table>

No correlations were computed but scatter diagrams were made for each of these two factors. These suggested very little correlation between either farm size and returns per $100 feed fed or between farm size and gross returns per crop acre. However, to the extent that any relationships did exist they were as indicated in Table 24. Certainly there was no positive correlation between farm size and returns per $100 feed fed. It is very likely that the quality of the land was as influential on crop returns as any superior management associated with larger farms might have been. The value of land per acre tended to be greater for larger farms.
Managerial ability

In light of the fact that positive correlations between income and size existed even for farms grouped by type, the fact that returns from livestock production were at least as high on small as on large farms and the fact that the portion of total work units represented by livestock and crops were similar in all cases, suggests that operator ability as manifested in organization of the farm and in technical efficiency did not vary greatly between farm sizes. This would indicate that for a given grade of management the relationships between size and income as already indicated are valid. This should not be interpreted to mean that every operator included in the study might manage a large farm equally well were he given the opportunity. Probably some individual small-scale operators might realize even less net income were they to take on a large unit, or some of those on large farms might actually have greater incomes were they to operate a smaller unit. There are many operators on small farms who might operate a large farm with an equal degree of efficiency. On the other hand some operators who are handling their own small unit as efficiently as large units are being handled by others might not possess the characteristics necessary to operate a large unit with the same degree of efficiency. Further, some operators who have the capital for a large unit but who operate it efficiently have greater incomes than if they were to operate a small farm with an equal degree of inefficiency — the benevolence of nature simply more than offsets their lack of technical and managerial
ability. These and other possibilities are not precluded by the statements already made. The fact that farm size may explain a major portion of the variation in farm income for all farms studied does not mean that this is the most important factor on any one farm. Or the statement that, as a group, farms falling in the various size ranges seem to be operated with comparable efficiency does not mean that all operators can manage large farms equally well.

Case studies

In order to investigate these possibilities further a few case studies have been made. Farms which deviated widely both above and below the regression line of net farm income on work units for 1942 were examined individually. A brief description of these follows.

1. **Farm A** represents a large unit with an income several times greater than might be expected on the basis of the regression of income on size for all farms. This farm of 1740 work units, operated by a young operator, had a net operator income of $59,170 and a net farm income of $61,514. The gross income was $111,904. The farm included 560 acres, 160 of which were owned and 400 of which were rented. Two hundred seventy-five of the 400 were cash rented. Of the 560 acres 526 were cropped and included 190 acres of corn, 116 acres of soybeans, 85 acres of oats and 157 acres of alfalfa and red clover hay. Yields for crops were above the average for the county; the corn averaged 94 bushels per acre, oats 57 and
soybeans 27. Livestock was the most important source of income. The gross income from livestock was $95,665. Thirteen thousand chickens were purchased and 12,190 were sold; 396 head of cattle were fed on the farm and 270 hogs were sold during the year. Livestock returns per $100 feed fed were $480. The farm employed the equivalent of 6 full-time men during the year. The operator's equity in working and liquid assets was $38,964 and in fixed assets was $11,400. This farm carried a high degree of risk and uncertainty in its exceedingly large volume, in the large amount of working capital and in land rented on a cash basis. It required a manager capable of handling other workers in a manner resulting in high productivity per worker. Probably only a few outstanding managers could operate a unit of this nature successfully.

2. Farm B represents a small unit with income twice that which might be expected. This owned farm, with only 147 work units, had a net operator income of $4,110. Livestock and crops were of near equal importance on this 80 acre farm. Crops grossed $37 per acre while the livestock returns were $209 for each $100 feed fed. The virtues of this operator were found in both the fact that rates of production were high and in that he kept expenses at a very low level. Little of the income represents appreciation of inventory values. The cost of machinery per crop acre was $1.41 while the cost of machinery and fuel was only $2.84 per acre. Livestock and crop enterprises dove-tailed well and no labor was hired. It
is entirely possible that this operator might operate a larger
farm with an equal degree of success.

3. Farm C with 1,389 work units might have been expected to return a
farm income of better than $18,000. The income was only $8,995.
This farm of 877 acres included 577 owned and 300 rented for cash.
Livestock was the most important source of income even though 300
acres were cropped. Crop yields were low even when compared with
other farms of the area. The gross value of crops per acre was $18.
Livestock included dairy cows, beef cows, feeder cattle, sheep and
poultry. Returns per $100 feed fed was only $125. Only 33 pigs
were saved per litter; dairy cows averaged 205 pounds of butterfat
and hens averaged 104 eggs. The farm was highly mechanised and a
relatively small amount of labor was used. Actually it appeared
that the operator was attempting to spread a small amount of labor
over too great an outlay. This farmer might well have had a
greater income had he been operating a smaller unit on a more
efficient basis.

4. Farm D, a moderately large farm with 835 work units, had a net income
of only $1,800 while four times this might have been expected. This
operator depended equally on livestock and crops as sources of income.
Crop yields were about average. The dairy and poultry enterprises
were operated with a high degree of efficiency but profits here
were evidently offset by the hog and feeder cattle losses. Low
returns on the hog enterprise were not due to high death losses but
more likely to inefficient feeding methods. An average number of pigs was saved per sow. Machinery and power expenses per crop acre were high. Again, this operator was one who might have best increased income by improving efficiency rather than by expanding scale of operations.

An examination of the above and other individual farms which deviated widely from the regression line indicated several things of importance. It appeared that there were many operators of small units who might have the ability to manage larger units. At the same time there were operators of large units who would probably have had greater income had they concentrated more effort on fewer work units. Some of the very large farms certainly could not be operated by the average operator.

In summary it can be said that the major portion of variation in farm income in 1939 and 1942 was associated with scale of operations. Organisation and efficiency of operations for small farms as a group was comparable to that of larger farms. However the characteristics of the individual are important. Some farmers are more nearly suited to large scale units than are others. These points should not be overlooked by prospective farm operators or those agencies concerned with settling operators on the land. In the first place it is of prime importance that the scale be large enough to provide an adequate family income. A size range probably exists for each operator within which he can operate with equal efficiency. For some operators this range may extend only
up to 250 work units; others may be able to handle 600 units as well as less. Still others may handle 2500 work units as efficiently as 200, 500 or 1500. The individual should, of course, be encouraged to push to a size great enough for an adequate income but not beyond the size range which matches his managerial capacity.

Costs and Returns by Scale of Operations

Net farm income might conceivably increase with scale of operations in two different manners: (1) It might result from lower costs as productive factors are combined more economically and as fixed costs are spread over a greater output \(^1\) and (2) It might result from greater volume alone even though costs were to remain constant or if output were pushed beyond the low cost combination and as long as the addition to cost was less than the addition to income.

Many persons have pointed to the first of these as all-important in agriculture. Predictions of large-scale and corporate farming generally rest on this factor. Some persons emphasizing this factor suggest that cooperative ownership of machinery and equipment represents a means of closing the cost and income gap between large and small farms.

Table 25 has been prepared in order to provide some answers as to the relative importance of costs on farm income as scale of operations.

---

\(^1\) Actually the two are identical inasmuch as a different combination is necessary to lower fixed costs. However, a new combination of some factors which increases returns can be made which does not lower average fixed costs.
The results of the study indicate that the operations performed by the team have not been conducted as expected. The team's performance, however, has not been affected as greatly.

The main focus of the study is made on the basis of the type of accounting used.

From these results, it can be concluded that the team's performance has not been affected as greatly as expected. However, some operations have been conducted as expected.

The results of the study have shown that the team's performance has not been affected as greatly as expected.

Cost reformation

The team of interest has taken a whole and provided some

Cost reformation

The team of interest has taken a whole and provided some

175
The table below shows the additional income required to move from one group to another, based on the lowest cost of each group. The data is presented in a tabular format, with columns indicating income levels and the corresponding costs.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

The formula to calculate the additional income required is: Additional Income = (Income - Lower Limit) x 0.025. This formula is used to determine the increase in income required to move from one group to another.

For example, if the income is $3000, the additional income required to move to the next group is: 3000 - 2999 = 1, 1 x 0.025 = 0.025, 0.025 x 1000 = 250.

Table 26 shows the additional income required to move from one group to another.
300-449 group has extended operations to a point of equal marginal costs and revenue while an individual farm of over 600 work units may not have reached this point.

**Returns from volume**

It is evident that, within a certain limit, average costs tend to decrease as scale of operations increases. This results as indivisibilities of resources are overcome and as fixed costs are spread over a greater output. Beyond a certain point costs tend to rise because of a greater proportion of hired labor, greater purchases of feed and livestock, duplication of certain equipment and perhaps because of some management difficulties. But the most important finding of Table 25 is revealed in a comparison of the increased returns due to lower costs with those due to volume alone. Even had average costs remained constant (instead of decreasing) each of the first four size groups would have had a greater net income than that of the immediately smaller size group. The largest size group had a greater net income than the next smaller size group in spite of the higher unit costs.¹ In every case, the increase in net income due to volume alone was much greater than that due to lower costs alone. All of the income advantage of the largest size group over the next smaller resulted from volume and not from lower costs.

This relationship suggests several things of importance. It is of course true that income can be increased somewhat on the small unit

¹This has to be true as long as marginal cost is less than marginal revenue.
through cooperative use of machinery and equipment. Such practices tend to spread certain fixed costs over a greater output and divide the total between several farms. Too, the development of small machines and power units which cut down on the overhead costs represents another possibility of increasing income on the small unit. More can be added to income, however, by increasing the scale of operations. Although the two go hand in hand within a certain range of farm size, lower costs are not as important as greater volume.

Actually, cooperative use of machinery as a method of realizing the economies of large-scale production means relatively little to the very small unit. For example, suppose that farms in the 0-149 size group had cooperated to the extent that their costs were decreased to the low of the 450-899 size group. This would have meant a saving of $9.45 per $100 gross income but would have increased net income by only $84. On the other hand, costs and other things remaining equal, a $500 increase in volume of business would have meant a $170 increase in net income.\(^1\) Obviously, the large farm has more income not so much because of its lower costs but because of the greater volume of business as such.

**Farm Size and Returns from Owning Versus Renting**

A problem which has to do with farm size arises when comparisons are made between returns on owned and rented farms. Some persons feel that

\(^1\)Assuming that costs per $100 gross income remain at $66.06 in order to show the advantage of size alone.
if one is to operate a small farm ownership will be more profitable
than tenancy and that the reverse will be true for large farms. Others
express an opposite opinion. In an attempt to throw some light on this
question a comparison of net operator income on owned and tenant farms
was made for the 1942 data.

Nature of relationships

On the basis of the data presented in Table 26 the tenant operators
on small units had larger incomes than did owner-operators. As Figure 7
suggests this relationship held up to a scale of approximately 288 work
units. Beyond this point the owner operator had greater net returns than
did tenant operators.

Table 26. Regression of net operator income on
farm size and related statistics,
1942 survey\textsuperscript{a}

<table>
<thead>
<tr>
<th>Tenure</th>
<th>Regression equation</th>
<th>$a_Y$</th>
<th>$s_b$</th>
<th>Value of regression coefficient at 5 per cent</th>
<th>Fiducial limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owned</td>
<td>$1.578X - 39.1^a$</td>
<td>25.45</td>
<td>.0949</td>
<td>1.762</td>
<td>1.388</td>
</tr>
<tr>
<td>Rented</td>
<td>$.995X + 79.3^a$</td>
<td>16.58</td>
<td>.1099</td>
<td>1.212</td>
<td>.778</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Income in terms of dollars and size in work units.

\textsuperscript{b}Differences between regression coefficients significant at the 1 per cent level of probability.

\textsuperscript{c}Regression Coefficient significant at the 1 per cent level of probability.
Reasons for relationships

There are reasons why a relationship of the general nature suggested here should exist. It is true that addition to size of an owned unit adds more to income than for a rented farm regardless of scale of operations since rents must be paid out of the tenant's production. Yet the owner starts out with greater first costs since, as the holder to the title of the real estate, he has certain fixed obligations which are not incurred by the tenant. These costs include depreciation and insurance on buildings, taxes, and interest on the real estate mortgage if one exists. The tenant, unless he pays cash rent, has no such large fixed costs. Were both the owner and the tenant of the small farm to produce nothing and thus incur no operating costs, the owner would have a greater less than the tenant since the latter would have only the animal non-variable costs associated with working capital while the former would also have fixed costs associated with land and improvements.\(^1\)

It may seem that rents should rise high enough to place the tenant on the small farm in a position comparable to that of the owner in respect to income. This does not have to hold true. Fixed costs such as taxes must fall on the land owner (even if they are relatively high on the small unit due to the regressive nature of assessments). Neither must

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\(^1\)Working capital usually designates such farm assets as machinery and breeding stock. Even though these were not used in production for a year the owner would still have some small costs in the form of taxes, obsolescence, insurance and perhaps interest.
Figure 8. Comparison of operator income on owned and rented farms, 1942.
fixed costs which arise in the case of buildings and other reproductive resources which result in high unit costs for the small farm come to rest on the tenant. As long as the number of medium-sized and large farms is greater rents will not be determined by the level of costs on small farms.

It has already been indicated that, on the basis of the data presented herein, the point at which the owner farm exceeds the tenant farm in respect to operator income appears to take place at about 288 work units. However, it may well be that this point might fall at a smaller (or larger) scale. Even on the basis of the 5 per cent level of fiducial limits for each regression coefficient, this point might come at as few as 171 work units.

It is felt that although the relationships suggested herein appear reasonable on a basis of both statistical and economic analysis, the problem posed merits further research. An analysis should be made for farms of different types. More records should be used in order to reduce the sampling error and thus better suggest the true range within which the point of transition occurs. It may be that the analysis should be made with acres used as the standard of measure since under a predominance of crop-share leases rents are tied closer to land than livestock.

Productivity of Labor

The family has always been the chief source of labor on Iowa farms. This was true for the majority of farms included in the 1939 data. It
was true for large farms as well as for small farms. Table 27 indicates that both large and small farms used a greater proportion of family labor than of hired labor. However, the relative importance of hired labor increased with scale of operations. For example, the smallest farms used 13.6 months of labor but 96.7 per cent of this was family labor. The farms in the size group 300-499 used 22.5 months of labor, 86.0 per cent of which was family labor while the largest farms used 32.8 months of which only 62.5 per cent was family labor.

Table 27. Use of family and hired labor, 1939 survey

<table>
<thead>
<tr>
<th>Size interval</th>
<th>Total labor</th>
<th>Family labor</th>
<th>Hired labor</th>
</tr>
</thead>
<tbody>
<tr>
<td>in work units</td>
<td>Months</td>
<td>Per cent</td>
<td>Months</td>
</tr>
<tr>
<td>0-149</td>
<td>13.5</td>
<td>100.0</td>
<td>13.0</td>
</tr>
<tr>
<td>150-399</td>
<td>17.4</td>
<td>100.0</td>
<td>15.9</td>
</tr>
<tr>
<td>300-499</td>
<td>22.5</td>
<td>100.0</td>
<td>19.6</td>
</tr>
<tr>
<td>400-599</td>
<td>27.5</td>
<td>100.0</td>
<td>19.6</td>
</tr>
<tr>
<td>600 &amp; over</td>
<td>32.8</td>
<td>100.0</td>
<td>20.4</td>
</tr>
</tbody>
</table>

The greater proportion of family labor employed is one important reason that the small farm with its meager income can exist side by side with the more efficient large-scale farm, or that the medium-sized unit is not forced to liquidate as is sometimes true in other industries. A sizeable portion of the labor used on many Iowa farms comes at practically no cost to the farm business. Part of it represents the work of teen-aged and school children or that of the housewife. This labor has few if any alternative opportunities for employment. It does not ordinarily show up as an expense in the farm's accounts because it does not receive a fixed
and established wage. If income is favorable the sea, for example, will have more spending money. If income is unfavorable he receives less. However, as operations are expanded this flexibility in labor costs tends to become less. More hired labor must be taken on at a definite cost to the business.

The increase in labor costs which accompany greater scale of operations should in part offset other economies of large scale. This does not hold true, however, because the large unit utilizes its labor more effectively. As Table 28 indicates, productivity of labor tends to parallel size of operations. In 1939 farms in the middle sized group produced 93 per cent more work units per year-round worker than did the small-sized group but only 85 per cent as many as the large size group. The greater labor costs on the larger farm tend to be more than offset by the greater output per worker.

Table 28. Work units produced per man equivalent, 1939 survey

<table>
<thead>
<tr>
<th>Size interval in work units</th>
<th>Total work units</th>
<th>Man equivalent</th>
<th>Work units produced per man equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-149</td>
<td>96.0</td>
<td>1.13</td>
<td>85.0</td>
</tr>
<tr>
<td>150-299</td>
<td>229.9</td>
<td>1.45</td>
<td>158.6</td>
</tr>
<tr>
<td>300-449</td>
<td>336.7</td>
<td>1.80</td>
<td>193.0</td>
</tr>
<tr>
<td>450-599</td>
<td>511.0</td>
<td>2.25</td>
<td>224.1</td>
</tr>
<tr>
<td>600 &amp; over</td>
<td>782.3</td>
<td>2.72</td>
<td>287.8</td>
</tr>
</tbody>
</table>

*Total months labor from Table 28 divided by 12.*
The less effective use of labor on the smaller units can not be entirely attributed to the choice of the operator. Rather it is often a necessary condition growing out of the scale of operations or factors conditioned by size. There are several reasons why more is accomplished per worker as the size of the unit increases. The larger farm simply has more work to do. The operator of the small farm, although willing to do additional work, often lacks the capital necessary to add or expand profitable enterprises; otherwise he would more often do so. The greater investment in capital, especially machinery and other labor-saving equipment, per worker makes it possible to accomplish more in a given amount of time. Larger crop and livestock enterprises do not require a proportionate increase in labor requirements. For example, the amount of labor is not doubled as the hog enterprise is increased from 5 to 10 litters or less time is spent per acre in cultivating a large field than a small field. Irregularly shaped fields on very small farms require more time for field operations. It is also true that a greater proportion of the operators of very small farms are of advanced age, in poor health or otherwise incapacitated for heavy labor. Even when allowance is made for differences in age and physical condition of workers, farms with a small volume of business use labor less effectively.

A certain number of persons operate small units simply because they wish to or can do little physical work. Especially included here is a group of semi-retired farmers and others who can not stand the physical strain of greater effort. Probably a greater number of farm operators, however, desire to use their labor more remuneratively. One method of
accomplishing this, where small scale operations prevent full use of labor, is through off-farm employment. This opportunity is not great in Iowa due to the lack of industrialization. The productivity and effectiveness of farm labor in Iowa hinges largely around scale of operations. This greater productivity of labor which accompanies greater scale of operations can not be brought about unless the necessary amount, and in turn, the proper forms of capital are available. The two problems, effective utilization of labor and availability of capital, are quite largely inseparable problems in agriculture. The interrelationship between efficiency in the use of labor and availability of capital is often times overlooked by farm management research workers. Some persons sort their farm records by size, show that income is greater on the larger farms, re-sort their records on a basis of efficiency in labor utilization and show a similar relationship between efficiency and income. These studies often imply that one simply has to increase labor efficiency to increase income. Actually, the group of farms showing the highest income in a farm size sort is roughly coincident with the high income group in a labor efficiency sort. Therefore, the great step-up in labor efficiency cannot be brought about unless size is increased. Size, in turn, cannot be increased unless the necessary capital is available.

Labor efficiency also varies with other factors not directly related to size. For example, more can be accomplished in a given amount of time if chore work is well routed, if gates, doors and feed bins are conveniently placed and if similar considerations are given to the planning
of the work. Yet there is no monetary premium on this method of increasing labor efficiency if scale of operations are small. As long as the operator is not busy full time and does not have outside employment, he has no less income if he spends a greater amount of time on routine work. Only when there are profitable alternatives for the use of labor can an operator increase his net income through employment of such labor-saving methods as those mentioned. Hence, even this means of labor efficiency may be indirectly related to farm size and availability of capital.

Even though availability of capital is a crucial factor, the operator with limited resources still has some power to control the effectiveness of labor utilization. He has the choice between operating a small owned unit or a larger rented unit. The former will mean a less efficient use of labor than the latter. It would be meaningless to suggest the larger rented unit as a means of utilizing labor more efficiently if such had to come at the expense of income. However, as was pointed out previously, the larger rented farm will, within limits, mean a greater operator income than a small owned unit not only because of lower costs but also because of greater volume alone.

Combination of Resources

A constituent of the farm income—farm size complex is the combination of resources. A premise of economic theory, closely related to that of the optimum-sized firm, is that of the optimum combination of productive factors. It has already been noted that the unit of optimum size (from
Investment tends to result in greater fixed cost per unit of output.

With costs of the greater investment in buildings per unit of output.

The second effect has to be

Table 29: Combination of Specialized Resources

<table>
<thead>
<tr>
<th>Worker</th>
<th>Factor (capital)</th>
<th>Land per acre</th>
<th>Farming interest</th>
<th>Price per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>75</td>
<td>178</td>
<td>103</td>
<td>1928</td>
<td>698</td>
</tr>
<tr>
<td>75</td>
<td>186</td>
<td>103</td>
<td>1928</td>
<td>698</td>
</tr>
<tr>
<td>75</td>
<td>186</td>
<td>103</td>
<td>1928</td>
<td>698</td>
</tr>
<tr>
<td>75</td>
<td>186</td>
<td>103</td>
<td>1928</td>
<td>698</td>
</tr>
</tbody>
</table>

The table overleaf has a cross-sectional view of the situation. The resource combination

operation is greater the rate of investment. The smaller the scale of

mechanization takes on an opposite relationship. This is when the interest per acre of land in each sector of a business.

One the other

refers to the product between farm size and resource size for the amount

the value in agriculture. Table 29 presents one such statement. The value

of resources is determined by the size of

of resources.

the rule in agriculture. How does this in turn affect the combination

either the cost or net income (not present in the equation rather than

189.
the relative share of net farm income

<table>
<thead>
<tr>
<th>R1</th>
<th>R2</th>
<th>3/3</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.7</td>
<td>2.7</td>
<td>2.7</td>
</tr>
<tr>
<td>1.7</td>
<td>1.7</td>
<td>1.7</td>
</tr>
<tr>
<td>1.7</td>
<td>1.7</td>
<td>1.7</td>
</tr>
<tr>
<td>1.7</td>
<td>1.7</td>
<td>1.7</td>
</tr>
<tr>
<td>1.7</td>
<td>1.7</td>
<td>1.7</td>
</tr>
</tbody>
</table>

Table 20 - Value of unpaid family labor as a percentage of net farm income, 1976 and 1977

Note: The value of unpaid family labor does not equal the net farm income. However, the contribution of these non-equivalent resources to total value added is small. However, the contribution of these non-equivalent resources to total value added is small. However, the contribution of these non-equivalent resources to total value added is small. However, the contribution of these non-equivalent resources to total value added is small. However, the contribution of these non-equivalent resources to total value added is small.
attributable to labor was less than in 1939 on small farms as well as on large farms but the same relationship to size still existed.

Returns to management

The return of the fourth factor of production, management, also constitutes a part of this income. A small amount of data on management return is included in Table 31. This study, like most farm management studies, indicates greater returns to management on larger farms. A

Table 31. Relationship of management return and farm size, a 1939 and 1942 surveys

<table>
<thead>
<tr>
<th>Size interval in work units</th>
<th>Returns to management (dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1939</td>
</tr>
<tr>
<td>0-149</td>
<td>-479</td>
</tr>
<tr>
<td>150-299</td>
<td>-295</td>
</tr>
<tr>
<td>300-449</td>
<td>-70</td>
</tr>
<tr>
<td>450-599</td>
<td>568</td>
</tr>
<tr>
<td>600 &amp; over</td>
<td>758</td>
</tr>
</tbody>
</table>

These figures were computed in the manner common to most farm management studies. The estimated returns to land, capital and family labor have been subtracted out of net income to give the residual which is usually termed management return. Obviously, this figure may include much beside the return attributable to management. In 1942, for example, a large component of this return included a windfall profit arising from the changes in price-cost relationships. This figure can be used in a rough way, however, to compare efficiency of operations between farms. It cannot be used satisfactorily to compare efficiency for one farm in different years or between types of farms for only one year.

part of this so-called management return cannot be attributed to management as such. Two of the several reasons that management returns are greater
The different forms of capital investment have been discussed in detail.

The extraction of some small farms was a common practice.

The small and family characteristic

Farms and management require

A study of the income concentration occurs when

includes from operating costs, resource in a more product

If the small unit as a manager, the reason the small unit may be related to the operator on the same number of units or capital is available for operation.

Economies and hence increase the so-called return to management action

Instead of the ability to take advantage of these

The greater the production and the greater productivity of labor. The greater management

of an large farm than on small farms are the lower costs per unit of
tends to decrease. The very large units are operated mostly by middle-aged or old men.

Table 32. Percentage distribution of operators by age groups and farm size, 1942 survey

<table>
<thead>
<tr>
<th>Size interval in work units</th>
<th>Age group*</th>
<th>0-29</th>
<th>30-59</th>
<th>60 &amp; over</th>
<th>All groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-149</td>
<td></td>
<td>18.7</td>
<td>57.6</td>
<td>22.7</td>
<td>100.0</td>
</tr>
<tr>
<td>150-499</td>
<td></td>
<td>15.5</td>
<td>66.7</td>
<td>16.8</td>
<td>100.0</td>
</tr>
<tr>
<td>500-999</td>
<td></td>
<td>9.3</td>
<td>76.2</td>
<td>12.6</td>
<td>100.0</td>
</tr>
<tr>
<td>1000-1999</td>
<td></td>
<td>7.2</td>
<td>83.7</td>
<td>9.1</td>
<td>100.0</td>
</tr>
<tr>
<td>2000 &amp; over</td>
<td></td>
<td>3.2</td>
<td>75.8</td>
<td>21.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*Differences between groups significant at the 5 per cent level of probability.

This age distribution represents various stages in the farm operations cycle. The small unit presents an opportunity for the young man with limited capital who wishes to begin farming. Were it necessary to start with an average-sized unit or none at all, many could not become farm operators. Too, the small unit is often a haven for the older man who does not wish to curtail his activities completely or for the physically incapacitated operator who wishes to farm but can not stand a great deal of heavy work. The medium-sized to moderately large units are operated mainly by middle-aged men since the capital requirements are too great for the young operator who must start out on his own or with only a small amount of help from others. The greater number of older men on the large unit may partly result since this represents an accumulation of those who have either not retired entirely or to a small unit. (Part may also
represent a sampling variation). Again, the capital requirements of the very large unit are beyond the assets owned by the young farmer unless he has inherited or has otherwise been the recipient of a fairly large sum.

It is well that some small units exist for the very purposes suggested above. The young beginner should not be expected to have an income on a par with that of an older operator. The semi-retired farmer does not always depend on the earnings of the small unit he operates. It may well be that he is operating only part of the land he owns or that he has income from other savings.

Actually, the entire problem of farm size and its relationship to farm income and family living touches upon sociological as well as economic spheres. For example as Table 33 indicates, the family on the small farm tends to include fewer persons than that of the larger farm. This is tied to the fact that the small-scale operator is more often a young man with only a few small children or an old man whose family is grown.

Table 33. Percentage distribution of family by size and farm size, 1942 survey

<table>
<thead>
<tr>
<th>Size interval in work units</th>
<th>Number in family in 1-4 persons</th>
<th>5 or more persons</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-149</td>
<td>37.4</td>
<td>12.6</td>
</tr>
<tr>
<td>150-399</td>
<td>84.4</td>
<td>15.6</td>
</tr>
<tr>
<td>300-449</td>
<td>94.6</td>
<td>25.4</td>
</tr>
<tr>
<td>450-699</td>
<td>63.5</td>
<td>35.3</td>
</tr>
<tr>
<td>600 &amp; over</td>
<td>61.6</td>
<td>39.2</td>
</tr>
</tbody>
</table>

*Differences between groups significant at the 1 per cent level of probability.*
It is evident that size of farm does not have the same meaning to all farm families. Some families can exist on a unit which might be considered as less than minimum from the average income standpoint. Obviously, families of two persons can be expected to make a living on a smaller unit than families of six persons. Young couples with small children will not require the same income for family living as will a family of the same size with older children. They will, of course, need a larger unit as the member in the family increases and as greater expenditures are required for growing children. Older couples with no children, or only grown children, can be looked upon as retirement cases rather than as operators which should or will increase scale of operations. As was indicated earlier, some persons on small units may not have the managerial ability to take on larger units. All such factors should be considered before adjustments are suggested to individual operators or before policies affecting farm capital and farm size are activated.

Farm Size and Capital Employed

The availability of capital is an important factor conditioning farm size and hence operator income in Iowa. This is apparent from the data presented in Table 84. Although the data of Table 84 are for all farms, similar relationships held for farms grouped by type-of-farming areas, type of farm and by tenure. Statistically, the correlation between work units and total capital was highly significant in each instance.

The figures in Table 84 roughly indicate the amount of capital required for owner or tenant operation of various sized units. The total
figure represents that required for the owner since he must invest in both working and fixed capital. The figure for working capital indicates that necessary for the tenant (except in cases of stock-share and similar rental relationships) since he does not invest in fixed capital. Not only may the tenant of the small unit realize a greater income than the owner-operator of a like unit, as was pointed out in an earlier section, but he can also operate a larger unit with a given amount of capital. This is a point which should be considered either by the prospective farmer or those who are concerned with settling people on the land and with formulating land tenure policies. It may well be more profitable for the person with limited capital to rent a medium-sized farm rather than to own a small farm. Certainly this is true within a certain range of farm size on the basis of data presented in Table 36.

Table 34. Relationship between farm size and specified types of capital, 1939 and 1942 surveys (dollars)

<table>
<thead>
<tr>
<th>Size interval in work units</th>
<th>1939 survey</th>
<th>1942 survey</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total capital</td>
<td>Working capital</td>
</tr>
<tr>
<td>0-169</td>
<td>6387</td>
<td>1115</td>
</tr>
<tr>
<td>150-299</td>
<td>12982</td>
<td>2241</td>
</tr>
<tr>
<td>300-449</td>
<td>22192</td>
<td>4446</td>
</tr>
<tr>
<td>450-599</td>
<td>29265</td>
<td>6088</td>
</tr>
<tr>
<td>600 &amp; over</td>
<td>42089</td>
<td>9600</td>
</tr>
</tbody>
</table>

Capital requirements by type of farm

An indication of the capital required for farms of different types and sizes is to be had from Figure 8 and Table 35. The total capital
Table 35. Regression of capital on farm size by
type of farm, 1939 survey

<table>
<thead>
<tr>
<th>Type of farm</th>
<th>Regression equation</th>
<th>$b_{y.x}$</th>
<th>$s_{My}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle feeding</td>
<td>$126.6 + .37 X$</td>
<td>.088</td>
<td>20,952</td>
</tr>
<tr>
<td>Crop</td>
<td>$1.5 + .70 X$</td>
<td>.086</td>
<td>10,822</td>
</tr>
<tr>
<td>Dairy</td>
<td>$7.5 + .29 X$</td>
<td>.045</td>
<td>7.089</td>
</tr>
<tr>
<td>Dual</td>
<td>$12.0 + .57 X$</td>
<td>.070</td>
<td>15,004</td>
</tr>
<tr>
<td>General</td>
<td>$-10.8 + .61 X$</td>
<td>.052</td>
<td>5.149</td>
</tr>
<tr>
<td>Hog</td>
<td>$45.7 + .45 X$</td>
<td>.033</td>
<td>6.353</td>
</tr>
</tbody>
</table>

\(a\) Total capital in hundreds of dollars and size in work units.

\(b\) Differences between regression coefficients significant at the 1 per cent level of probability.

\(c\) Regression coefficient significant at the 1 per cent level of probability.

Investment for a unit of given size, as measured in work units, is lower for dairy farms than for other types. The investment for the crop farm tends to be greatest. Or conversely, a given amount of capital will support a larger dairy unit than other types of farms. For example, a $15,000 investment would, on the basis of price levels existing in 1939, allow a scale of 291 work units for a dairy farm, 510 for a hog farm and 212 for a crop farm. These relationships are obviously tied closely to the labor requirements for the enterprise under consideration. The investment of $150 in two dairy cows valued at $75 each would call for around 280 hours of labor per year. The same investment in three acres of land valued at $50 per acre would, on the average, call for around twenty-one hours of labor if the land were planted to oats or forty-eight hours if planted to corn.
At the level of a $15,000 investment, the scale of a cattle feeding farm would be less than for any other type of farm on the basis of the computed regressions. The number of work units possible at 1939 prices would be only sixty-three for this type of farm. However, due to the values of a and b in the regression equation, an investment of $45,000 would allow a cattle feeding farm on a scale greater than for crop, dual purpose and hog farms and nearly as large as for dairy and general farms. These figures suggest that a large initial investment is required for the cattle-feeding farm but that, after this initial investment, additional size can be added at only a small investment. Several things cast doubt especially upon the level and, to some extent, on the slope of the regression line for cattle-feeding farms. No great investment in land or equipment is required for cattle-feeding operations. Certainly the necessary investment in equipment is less than for dairy cattle. The investment in land required per work unit of feeder cattle is less than that for crops. Finally, as Table 35 indicates, the errors of estimate are greater for cattle-feeding than for other types of farms. Even within sampling limits the true population regression for cattle-feeding farms could vary much more from the computed regression than for most other types of farms studied.

Capital requirements and returns by type-of-farming areas

Some persons feel that with limited capital it is better to invest in an area of low-priced land since this will allow a larger unit than
Figure 9. Capital requirements by type of farm, 1939.
will a like investment in an area of high-priced land. This is true between type-of-farming areas in Iowa as can be seen from the data in Table 36 and from the relationships expressed in Figure 9. A given amount of capital will support a large physical unit in the Southern Pasture area of Iowa since the value of land is low relative to other areas. Similarly, the investment required for a given number of work units in the Northeast Dairy area is less than for the three remaining areas, partly because of lower land values but also because labor requirements per investment in dairy cows are high. The investment per work unit in the Cash Grain area is high due to the fact that land values are high and also to the fact that cash grain farming is important relative to livestock in the area. Labor requirements are low relative to the total capital investment required for crop production in Iowa.

Table 36. Regression of capital on farm size by type-of-farming area, 1939

<table>
<thead>
<tr>
<th>Area</th>
<th>Regression equation</th>
<th>$\beta_0 X$</th>
<th>$\beta_1 X$</th>
<th>$\beta_2 X$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northeast Dairy</td>
<td>$40.1 + .423 X$</td>
<td>.0287</td>
<td>5.2005</td>
<td></td>
</tr>
<tr>
<td>Cash Grain</td>
<td>$62.8 + .546 X$</td>
<td>.0357</td>
<td>7.5769</td>
<td></td>
</tr>
<tr>
<td>Western Livestock</td>
<td>$28.2 + .539 X$</td>
<td>.0395</td>
<td>5.0062</td>
<td></td>
</tr>
<tr>
<td>Southern Pasture</td>
<td>$1.8 + .465 X$</td>
<td>.0292</td>
<td>4.8159</td>
<td></td>
</tr>
<tr>
<td>Eastern Livestock</td>
<td>$7.0 + .572 X$</td>
<td>.0377</td>
<td>7.1986</td>
<td></td>
</tr>
</tbody>
</table>

*Total capital in hundreds of dollars.

*Differences between regression coefficients significant at the 1 per cent level of probability.

*Regression coefficient significant at the 1 per cent level of probability.
Figure 10. Capital requirements by type-of-farming area, 1939.
More important than the physical scale of operations which can be supported from a given investment in areas of various land values is the return forthcoming from the investment. Although a given amount of capital will purchase a larger unit in the Southern Pasture area, will it, for example, return a greater income than a like investment in the Cash Grain area?

In an attempt to throw some light on this question a comparison of the regression of income on capital has been made by type-of-farming areas. The relevant statistics are included in Table 37. According to these data the returns from a given amount of capital tended to be smallest in the Southern Pasture area and the Cash Grain area, the areas of lowest and highest land values. Further, the returns in the Cash Grain area were considerably less than for the Southern Pasture area.

Table 37. Regression of net farm income on total capital investment, by areas, 1939 survey

<table>
<thead>
<tr>
<th>Area</th>
<th>Regression equation</th>
<th>r&lt;sub&gt;x,y&lt;/sub&gt;</th>
<th>b&lt;sub&gt;y,x&lt;/sub&gt;</th>
<th>( \sum y^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northeast Dairy</td>
<td>8.259 X - 103.8&lt;sup&gt;*&lt;/sup&gt;</td>
<td>.550</td>
<td>56.098</td>
<td></td>
</tr>
<tr>
<td>Cash Grain</td>
<td>5.303 X + 537.3&lt;sup&gt;*&lt;/sup&gt;</td>
<td>.615</td>
<td>91.615</td>
<td></td>
</tr>
<tr>
<td>Western Livestock</td>
<td>8.402 X - 81.8&lt;sup&gt;*&lt;/sup&gt;</td>
<td>.615</td>
<td>126.715</td>
<td></td>
</tr>
<tr>
<td>Southern Pasture</td>
<td>7.190 X + 109.8&lt;sup&gt;*&lt;/sup&gt;</td>
<td>.620</td>
<td>56.535</td>
<td></td>
</tr>
<tr>
<td>Eastern Livestock</td>
<td>7.333 X + 43.5&lt;sup&gt;*&lt;/sup&gt;</td>
<td>.594</td>
<td>79.843</td>
<td></td>
</tr>
</tbody>
</table>

<sup>*</sup>Capital in hundreds of dollars.

<sup>1</sup>Differences between regression coefficients significant at the 1 per cent level of probability.

<sup>2</sup>Regression coefficient significant at the 1 per cent level of probability.
These relationships suggest that land is relatively over-priced in areas of both high and low productivity. If land were capitalized according to its earning ability this relationship would not hold. It is entirely possible, however, that the competition for land both high and low in productivity is great enough to drive the price above the earning power. The discrepancy might arise in the high value areas because of the individual's pride in owning high-producing land and in the low value areas because of the numbers of persons who wish to buy farms with a small amount of capital.

The above analysis may be a first approximation of the true relationship between type-of-farming areas. It may also be true that the relationships suggested herein are confounded with others if land value groups alone were to be considered. For this reason the problem posed merits further study. Data from several years should be studied in order to avoid price relationships which favor any one value group. Too, relationships might be more clearly isolated if land value groups were delineated not by type-of-farming area but by other criteria.
Figure 11. Relation of net farm income to capital investment by type-of-farming area 1939.
SUMMARY AND CONCLUSIONS

Farm Size Adjustments

Many predictions relative to farm size adjustments have been made over the past two decades. These predictions, revolving around mechanization and implying the static theory of the firm, have suggested large increases in the number of acres per farm. However, there is little evidence that the change in farm size has been as great as was commonly expected. Changes have often been greater in areas where mechanization has not been important than in highly mechanized areas.

A consideration of the non-static theory of the firm throws some light on why adjustments have not been as great as might be expected. Yet any analysis of farm size adjustments must consider additional factors which are peculiar to agriculture and which are not included in the assumptions of the theory of the firm: (1) Capital is not so readily accessible as is assumed in the theory of the firm. The farm operator tends to push scale of operations to that which is possible in terms of the capital he owns and can (or is willing) to borrow. (2) The farm includes the household as well as the firm. The labor is mainly that of the family and often does not receive a definite wage. The farm represents a hard-won home which the family is reluctant to leave. (3) The firm in agriculture is a one-generation affair. The process of capital accumulation
must start over with each generation. (4) The market for productive factors is highly imperfect. It is impossible to add acres to one farm plant except as other farmers relinquish operation of their units. Even then the unit made available is not always of a desirable size and location and obtainable at reasonable terms. (5) The typical farm operator will remain on the farm as long as the returns from all his resources compare favorably with those which he might earn for his labor elsewhere or as long as he is able to meet commitments.

Within this framework of conditions, mechanisation may or may not force larger units. It makes possible the operation of more acres with the same amount of labor and similar amounts of capital. However, one operator cannot increase his acreage until additional land becomes available. Hence, two general cases can be established: (1) If mechanisation encourages a greater acreage of the crop the price of the commodity will drop and the income of the small-scale operator who retains the old technique will be less than formerly. This lower income will encourage some small-scale operators to turn to other occupations. The remaining operators can then expand their acreage. (2) If the mechanical development is not accompanied by a greater acreage of the crop there will be no such tendency toward an increased farm size. The operator of the small unit will still have as great an income as formerly and as long as he remains in farming his unit cannot be consolidated with others. The outcome may, of course, vary with tenure arrangements.
Other factors may be equal to or greater than mechanization as forces bringing about farm size adjustments. Any factor which tends to lower incomes will force some operators from their units and may thus make possible the consolidation of farms. The outcome will again vary with tenure arrangements.

In Iowa the greatest single adjustment in farm size took place soon after the state was settled. The original modal unit was the 320 acre claim of the "squatter". The modal size dropped to 160 acres once sale of the public domain was initiated. For the eighty-year period, 1840-1920, the trend in farm size was mainly in the direction of medium sized units.

Since 1920 there has been a very gradual trend toward larger units. Mechanization has been the development making possible this trend although it has not always been the initiating force. The number of consolidations has not been as great as many have supposed and it appears unlikely that mechanization will revolutionize the size of Iowa farms in the next several decades.

The pattern of farm size adjustments has varied by type-of-farming areas in Iowa. There has been little or no change in the Northeast Dairy area. The greatest number of consolidations has taken place in the Southern Pasture and Western Livestock areas. Some consolidation has taken place in the Cash Grain and Eastern Livestock areas although the number has not been great. If mechanization had been the causal factor the pattern of adjustment should have been greatest in the level areas and least in the rough areas of the state. It appears that although
mechanization has made possible larger units, other factors such as drought and depression have been the forces initiating the adjustments in Iowa.

**Relationship of Income to Farm Size**

An analysis of farm income data for 1939 and 1942 sample surveys indicates a statistically significant correlation between net farm income and farm size as measured in work units. Farm size explained 50.5 per cent of the variance in farm income for all farms in 1939 and 52.5 per cent in 1942. The correlation between farm size and farm income varied for farms grouped by types. It was greatest for dairy and crop farms and lowest for cattle-feeding farms.

The relationship between income and size was one of constant returns to scale for all types of farms and all type-of-farming areas except the Cash Grain area. The relationship appeared to be one of decreasing returns for this area. Although the relationship may be one of constant returns to scale for all farms taken together the relationship may well vary for different intervals of farm size.

The over-all farm organization and the efficiency of operations of small farms was comparable to that of large farms. However, not all persons are equally able to manage a large farm. The scatter of incomes was much greater for farms in the large size interval than for farms falling in the small and medium size interval.

The size of the farm has far-reaching effects on the combination and productivity of resources employed by the farm operator. The large
farm has a greater total capital, more working capital and more land
per worker than does the small farm. The productivity per worker thus
parallels the size of the farm. Conversely, the investment in improve-
ments per given area of land tends to be greatest on the small farms.
This relationship results in higher fixed costs per unit of output on
the small farms.

As the size of the farm increases net farm income increases for two
reasons: (1) Certain economies are realized and average costs are lowered
as resources are combined more efficiently. (2) The additional volume
of business increases net income as long as total expenses do not increase
by a like amount. The analysis of the 1939 data indicates that the large
farm has a greater income not so much because of its lower costs but
because of its additional volume of business.

The analysis of the 1940 data indicates that small tenant-operated
farms have greater income than small owner-operated farms. This relation-
ship holds true on small farms since the owner-operator incurs certain
fixed costs which are not covered by the rent of the land.

Small units tend to be operated by beginning farmers who do not have
the capital for larger units and by older men who are physically unable
to operate larger units. A number of small farms is justifiable in
that these persons are given an opportunity to carry on operations.

Availability of capital is the most important factor limiting scale
of operations on Iowa farms. It is not until sufficient capital is
available that the operator can expand operations and combine resources in the most economic manner. The size of the unit which can be supported with a given amount of capital depends, of course, on the type of farm and the type-of-farming area selected by the operator.
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82. Viner, J. Cost curves and supply curves. Zeitschrift für Nationalökonomie. Bd. III. 1931. (Original not read; article reprinted in English by the University of Chicago).


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Table A. Changes in size of farms by region and tenure groups in the United States, 1920 to 1940

<table>
<thead>
<tr>
<th></th>
<th>Tenant farms</th>
<th>Owner farms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1920</td>
<td>1940</td>
</tr>
<tr>
<td>Average acres:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>per cent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>157.3</td>
<td>148.0</td>
</tr>
<tr>
<td>Eastern dairy</td>
<td>111.0</td>
<td>107.5</td>
</tr>
<tr>
<td>Western dairy</td>
<td>154.6</td>
<td>149.9</td>
</tr>
<tr>
<td>Eastern cotton</td>
<td>50.1</td>
<td>68.6</td>
</tr>
<tr>
<td>Delta cotton</td>
<td>38.4</td>
<td>46.0</td>
</tr>
<tr>
<td>Western cotton</td>
<td>133.5</td>
<td>182.0</td>
</tr>
<tr>
<td>Small grain</td>
<td>304.4</td>
<td>346.1</td>
</tr>
<tr>
<td>Range</td>
<td>374.5</td>
<td>481.6</td>
</tr>
</tbody>
</table>

Source: United States Census.

*Full-owners

*Illinois, Indiana, Iowa and Ohio.


*Michigan, Minnesota and Wisconsin.

*Alabama, Georgia and South Carolina.

*Arkansas, Louisiana and Mississippi.

*Oklahoma and Texas.

*Kansas, Montana, Nebraska, North Dakota, and South Dakota.

*Arizona, Idaho, Nevada, New Mexico and Utah.
<table>
<thead>
<tr>
<th>Size group (in acres)</th>
<th>1880</th>
<th>1890</th>
<th>1900</th>
<th>1910</th>
<th>1920</th>
<th>1925</th>
<th>1930</th>
<th>1935</th>
<th>1940</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-19</td>
<td>5,529</td>
<td>5,590</td>
<td>11,648</td>
<td>13,724</td>
<td>11,562</td>
<td>18,125</td>
<td>15,622</td>
<td>18,531</td>
<td>18,622</td>
</tr>
<tr>
<td>20-49</td>
<td>28,488</td>
<td>38,418</td>
<td>21,476</td>
<td>15,676</td>
<td>18,117</td>
<td>12,693</td>
<td>12,179</td>
<td>13,819</td>
<td>13,003</td>
</tr>
<tr>
<td>50-99</td>
<td>50,619</td>
<td>53,846</td>
<td>49,665</td>
<td>33,712</td>
<td>35,989</td>
<td>34,828</td>
<td>32,209</td>
<td>34,286</td>
<td>32,146</td>
</tr>
<tr>
<td>100-174</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>80,121</td>
<td>85,594</td>
<td>86,573</td>
<td>84,722</td>
<td>84,917</td>
<td>82,393</td>
</tr>
<tr>
<td>175-359</td>
<td>95,163&lt;sup&gt;b&lt;/sup&gt;</td>
<td>121,003&lt;sup&gt;b&lt;/sup&gt;</td>
<td>142,676</td>
<td>40,304</td>
<td>41,414</td>
<td>41,475</td>
<td>42,615</td>
<td>43,942</td>
<td>41,452</td>
</tr>
<tr>
<td>250-499</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>25,841</td>
<td>23,965</td>
<td>23,503</td>
<td>25,546</td>
<td>25,619</td>
<td>26,119</td>
</tr>
<tr>
<td>500 &amp; over</td>
<td>2,662</td>
<td>3,586</td>
<td>5,158</td>
<td>2,644</td>
<td>2,014</td>
<td>1,892</td>
<td>2,136</td>
<td>2,198</td>
<td>2,583</td>
</tr>
<tr>
<td>All farms</td>
<td>185,351</td>
<td>201,905</td>
<td>223,622</td>
<td>217,044</td>
<td>213,459</td>
<td>213,490</td>
<td>214,923</td>
<td>221,986</td>
<td>213,816</td>
</tr>
</tbody>
</table>

Source: United States Census.

<sup>a</sup>Data not available.

<sup>b</sup>100-499 inclusive.
Table C. Percentage distribution of all farms by size, Iowa, Census years 1880-1940

<table>
<thead>
<tr>
<th>Size group</th>
<th>1880</th>
<th>1890</th>
<th>1900</th>
<th>1910</th>
<th>1920</th>
<th>1925</th>
<th>1930</th>
<th>1935</th>
<th>1940</th>
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<tbody>
<tr>
<td>in acres</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0- 19</td>
<td>5.0</td>
<td>3.7</td>
<td>5.1</td>
<td>6.5</td>
<td>5.4</td>
<td>6.1</td>
<td>7.2</td>
<td>8.5</td>
<td>7.7</td>
</tr>
<tr>
<td>20- 49</td>
<td>12.7</td>
<td>9.2</td>
<td>9.5</td>
<td>7.5</td>
<td>6.1</td>
<td>5.9</td>
<td>5.7</td>
<td>6.0</td>
<td>6.7</td>
</tr>
<tr>
<td>50- 99</td>
<td>31.6</td>
<td>25.4</td>
<td>21.7</td>
<td>17.6</td>
<td>16.8</td>
<td>16.2</td>
<td>15.6</td>
<td>15.4</td>
<td>15.1</td>
</tr>
<tr>
<td>100-174</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>38.9</td>
<td>40.1</td>
<td>40.5</td>
<td>39.4</td>
<td>38.3</td>
<td>38.6</td>
</tr>
<tr>
<td>175-259</td>
<td>51.3</td>
<td>59.9</td>
<td>62.4</td>
<td>19.3</td>
<td>19.4</td>
<td>19.4</td>
<td>19.8</td>
<td>19.1</td>
<td>19.4</td>
</tr>
<tr>
<td>260-499</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>10.7</td>
<td>11.2</td>
<td>11.0</td>
<td>11.9</td>
<td>11.5</td>
<td>12.3</td>
</tr>
<tr>
<td>500 &amp; over</td>
<td>1.4</td>
<td>1.8</td>
<td>1.3</td>
<td>1.2</td>
<td>1.0</td>
<td>.9</td>
<td>1.0</td>
<td>1.0</td>
<td>1.2</td>
</tr>
<tr>
<td>All farms</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: United States Census.

*Data not available.

b100-499 inclusive.
Table D. Numbers of farms 0-19 acres in size, by type-of-farming area in Iowa. Census years 1920-1940

<table>
<thead>
<tr>
<th>Area</th>
<th>1920</th>
<th>1930</th>
<th>1940</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northeast Dairy</td>
<td>2,277</td>
<td>2,304</td>
<td>2,701</td>
</tr>
<tr>
<td>Cash Grain</td>
<td>1,972</td>
<td>3,095</td>
<td>3,575</td>
</tr>
<tr>
<td>Western Livestock</td>
<td>1,856</td>
<td>2,911</td>
<td>3,257</td>
</tr>
<tr>
<td>Southern Pasture</td>
<td>2,273</td>
<td>3,076</td>
<td>3,287</td>
</tr>
<tr>
<td>Eastern Livestock</td>
<td>2,163</td>
<td>4,123</td>
<td>3,822</td>
</tr>
</tbody>
</table>

Source: United States Census
Table E. Work unit conversion factors

<table>
<thead>
<tr>
<th>Crop</th>
<th>Work units per acre</th>
<th>Livestock</th>
<th>Work units per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>.7</td>
<td>Beef cow</td>
<td>3.0</td>
</tr>
<tr>
<td>Corn for grain</td>
<td>1.6</td>
<td>Dairy cow</td>
<td>14.0</td>
</tr>
<tr>
<td>Corn for silage</td>
<td>2.2</td>
<td>Feeder cattle</td>
<td>2.5</td>
</tr>
<tr>
<td>Flax</td>
<td>1.0</td>
<td>Young stock</td>
<td>2.5</td>
</tr>
<tr>
<td>Oats</td>
<td>.7</td>
<td>Fall litter</td>
<td>4.2</td>
</tr>
<tr>
<td>Soybeans for grain</td>
<td>1.0</td>
<td>Spring litter</td>
<td>4.0</td>
</tr>
<tr>
<td>Soybeans for hay</td>
<td>1.2</td>
<td>Sheep</td>
<td>.6</td>
</tr>
<tr>
<td>Wheat</td>
<td>1.0</td>
<td>Turkey</td>
<td>.57</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>1.9</td>
<td>Hens (100)</td>
<td>17.0</td>
</tr>
<tr>
<td>Mixed hay</td>
<td>.8</td>
<td>Chicks (100)</td>
<td>3.0</td>
</tr>
<tr>
<td>Sorghum hay</td>
<td>1.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wild hay</td>
<td>.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ACKNOWLEDGEMENTS

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